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TRANSIT RELIABILITY INFORMATION PROGRAM PARTICIPANTS GUIDELINES

DYNAMICS RESEARCH CORPORATION
SYSTEMS DIVISION
60 Concord Street
Wilmington, MA 01887

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FINAL REPORT
MARCH 1981

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Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
URBAN MASS TRANSPORTATION ADMINISTRATION
Office of Technology Development and Deployment
Office of Rail and Construction Technology
Washington DC 20590

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16. Abstract

The Transit Reliability Information Program (TRIP) is a government-initiated program to assist the transit industry in satisfying its need for transit reliability information. TRIP provides this assistance through the operation of a national Data Bank. This Data Bank collects, stores, and analyzes data which is generated by transit operators during the course of revenue service operation and equipment maintenance. The results of the periodic analyses of the stored data are distributed to TRIP participants and users.

This report has been prepared as a "User's Manual" for the TRIP Data Bank. It is designed to familiarize prospective participants and users of TRIP with the operation, capabilities, and use of the TRIP Data Bank. The Participants Guidelines describe: the purpose, or role, of a data source; the types of data and information solicited for input to the Data Bank; recommended procedures for submitting data; the types of routine reports produced by the Data Bank; and the types of special reports and services that can be provided by the Data Bank to individual users.

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PREFACE

This document provides guidelines for participation in the Transit Reliability Information Program (TRIP). These TRIP Participants Guidelines have been prepared by Dynamics Research Corporation (DRC) under contract number DOT-TSC-1559, which is sponsored by the Urban Mass Transportation Administration and issued by the United States Department of Transportation (DOT), Transportation Systems Center (TSC).

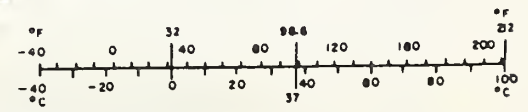
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^2
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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Transportation Systems Center
Cambridge, Massachusetts 02142

16. Abstract

This document provides guidelines for participation in the Transit Reliability Information Program (TRIP). TRIP is a government-initiated program designed to assist the transit industry in satisfying its need for transit equipment reliability data. TRIP provides this assistance through the operation of a national Data Bank. The primary purpose of the TRIP Data Bank is to provide a computer-based system for the collection, analysis, and reporting of reliability information on transit equipment. This information is generated by transit operations during the course of revenue service operation and equipment maintenance. The results of the periodic analyses of the stored data are distributed to TRIP participants and users.

This report has been prepared as a "User's Manual" for the TRIP Data Bank. It is designed to familiarize prospective participants and users of TRIP with the operation, capabilities, and use of the Data Bank. As a Participants Guidelines, this report describes the role of a data source, the types of data and information solicited for input to the Data Bank, recommended procedures for submitting data, the types of routine reports produced by the Data Bank, and the types of special reports and services that can be provided by the Data Bank to individual users. Ultimately, TRIP will encompass all classes of transit equipment, including, for example, rail rapid vehicles; track and structures; wayside ATO/ATC; transit buses; automatic fare collection, etc. The development of the Data Bank is being accomplished through an approach of phased implementation. Also, these Guidelines will be periodically revised and updated to reflect improvements in the TRIP Data Bank and experience gained by the transit industry as a result of TRIP.

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LIST OF ABBREVIATIONS

APTA	American Public Transit Association
BART	Bay Area Rapid Transit District
CTA	Chicago Transit Authority
DOT	U.S. Department of Transportation
DRC	Dynamics Research Corporation
EDB	Experimental Data Bank
GCRTA	Greater Cleveland Regional Transit Authority
GPL	Generic Parts List
GPN	Generic Part Number
GSN	Generic Serial Number
MGPL	Master Generic Parts List
MREL	Master Reliability Equipment List
NYCTA	New York City Transit Authority
PATCO	Port Authority Transit Corporation
REL	Reliability Equipment List
TDB	TRIP Data Bank (full-scale versus EDB)
TIDS	Technical Integrated Data System
TRIP	Transit Reliability Information Program
TSC	Transportation Systems Center
UCC	Universal Component Code
UMTA	Urban Mass Transportation Administration
WMATA	Washington Metropolitan Area Transit Authority

SECTION 1 - INTRODUCTION

This document provides guidelines for participation in the Transit Reliability Information Program (TRIP). These TRIP Participants Guidelines have been prepared by the Dynamics Research Corporation (DRC) under Contract Number DOT-TSC-1559, issued by the U.S. Department of Transportation (DOT), Transportation Systems Center (TSC).

TRIP is a government-initiated program to assist the transit industry in satisfying its need for transit reliability information. TRIP provides this assistance through the operation of a national reliability Data Bank. This Data Bank collects, stores, and analyzes data which is currently being generated by transit operators in the course of revenue service operation and equipment maintenance. The results of periodic analyses of the stored data are distributed to TRIP participants and users.

These Guidelines will be periodically revised and updated to reflect improvements in the TRIP Data Bank and experience gained by the transit industry as a result of TRIP. Comments on this document or questions concerning its latest revision should be submitted to:

U.S. DEPARTMENT OF TRANSPORTATION
Research and Special Programs Administration
Transportation Systems Center
Transit Systems Branch, DTS-722
Cambridge, Massachusetts 02142

1.1 PURPOSE AND SCOPE

This Guidelines document has been prepared as a users manual for the TRIP Data Bank. It is designed to familiarize a prospective participant or user of TRIP with the operation, capabilities, and use of the TRIP Data Bank.

For the participant, these Guidelines describe: the purpose, or role, of a data source; the types of data and information solicited for input to the Data Bank; recommended procedures for submitting data; and cost considerations versus the benefits of participation.

For both user and participant, these Guidelines provide a description of the types of output reports currently being produced by the Data Bank and various "special services" which can be provided. Procedures are included for requesting modifications to or new "routine" output reports, and for requesting "special services" and/or reports.

A section is also included in these Guidelines to present a practical approach to performing reliability analysis in a field environment with less-than-ideal data. This approach is the foundation upon which the TRIP Data Bank has been built.

It should be noted that TRIP is a dynamic program, responsive to the changing requirements of the transit industry. As a result, the descriptions, procedures, and output report formats presented herein are subject to change without notice. Prospective participants and users of TRIP are therefore encouraged to contact the Transportation Systems Center to obtain the latest revisions of these Guidelines.

1.2 BACKGROUND

The Transit Reliability Information Program (TRIP) is a government initiated response to an acknowledged need to collect and analyze rail transit equipment reliability data on a national level. The goals of TRIP are to:

- Amalgamate current reliability efforts within the transit industry, and provide a focal point for a consolidated reliability effort;
- Promote uniform reliability related definitions for the transit industry;
- Provide a central repository for voluntary submittal of transit industry field failure data;
- Provide uniform processing and analysis of reliability data;
- Provide means for periodic distribution of reliability data to potential users;

- Provide data for factual comparison of reliability between related equipments;

- Provide substantive data for specifying new equipment procurements, justifying product improvement projects, and supporting system analysis programs.

TRIP has been designed as a three-phase program. Phase I consists of:

- Definition and scoping of the functional and operational requirements of the TRIP Data Bank;

- Design, implementation, operation, and enhancement of a Rail Rapid Vehicle (RRV) Experimental Data Bank (EDB) for the purpose of evaluating the design concepts of the (full-scale) TRIP Data Bank on a prototype scale;

- Design, implementation, operation, and enhancement of an EDB for Buses.

Phase II consists of merging the two EDBs into a single data bank and expanding the scope of the data bank to include all aspects of vehicles involved. Phase III will be the expansion of the TRIP Data Bank to include other classes of transit equipment.

TRIP is currently in Phase I. The initial TRIP support contract was issued to the Dynamics Research Corporation in September, 1978, by the U.S. Department of Transportation (DOT), Transportation Systems Center (TSC) for the purpose of planning and establishing a program to collect and evaluate reliability information on new and existing transit vehicles. This contract focused on TRIP for Rail Rapid Vehicles (RRV TRIP) and included the definition and scoping of the full-scale TRIP Data Bank and establishment of the RRV Experimental Data Bank.

The American Public Transit Association (APTA), under separate contract to TSC, established the TRIP Liaison Board consisting of representatives from U.S. rail transit authorities and transit equipment manufacturers. The Liaison Board has provided continuous guidance for the development of TRIP and the EDB through a series of periodic meetings. From the Liaison Board membership, six transit

authorities volunteered at the contract "Kick-off meeting" to participate in the development of TRIP by supplying data to the EDB. The six properties are:

BART	Bay Area Rapid Transit District;
CTA	Chicago Transit Authority
GCRTA	Greater Cleveland Regional Transit Authority;
NYCTA	New York City Transit Authority;
PATCO	Port Authority Transit Corporation;
WMATA	Washington Metropolitan Area Transit Authority.

The development of the TRIP Data Bank began with an investigation of existing reliability data banks and an analysis of the data collection and reporting approaches being used in the transit industry. Particular emphasis was placed upon the six EDB properties. The results of these investigations were used to formulate a functional definition of the TRIP Data Bank. Each of the required TRIP Data Bank functions was further defined into modular "elements" which were then translated into preliminary design requirements and specifications. A chronological summary of the TRIP Data Bank development is presented in DRC Report Number R-341U, "TRIP Phase I Report". See Section 1.3, herein, for a complete list of reference documents.

Part of the TRIP Data Bank design included the development of a uniform system of transit vehicle component identification. This parallel activity resulted in the formulation of the "Generic Part Number" (GPN), a code by which equipment of similar function is classified and grouped according to that function. The purpose of the GPN is to provide a common numbering system to which the individual part numbering systems used at the various transit properties can be cross-referenced. The GPN is the major "key" by which component data is stored in the TRIP Data Bank and, because of its orientation toward equipment function, provides a means for efficient data retrieval in support of analytical comparison of functionally similar equipment. Procedures were subsequently developed for preparing the "Generic Parts List" (GPL), the cross-reference table of transit property part numbers versus Generic Part Numbers.

The design and implementation of the Experimental Data Bank began early in 1979. The purpose of the EDB was to provide a model or prototype of the TRIP Data Bank so that

the various aspects of the emerging Data Bank design could be tested and refined prior to full-scale implementation. The TRIP Liaison Board recommended three rail vehicle subsystems (doors and door controls, propulsion, and friction brakes) for use as "pilot equipment" in the EDB.

Following the successful completion of the Software Acceptance Test, the TRIP Experimental Data Bank began operation on August 6, 1979, with the input of July data from BART and WMATA. EDB refinement and expansion have been on-going activities since the initiation of operation. Expansion of the "input side" of the EDB continued with the inclusion of CTA and PATCO in November, 1979, and NYCTA in February, 1980. (GCRTA will be brought on-line early in 1981.) The EDB currently contains data going back to August 1, 1979, for CTA and PATCO, and July 1, 1979, for BART, NYCTA, and WMATA.

The first EDB Output Report was published in September, 1979, and contained the July data from BART and WMATA. The TRIP Liaison Board reviewed the report and recommended several modifications to format and content. EDB Output Reports were subsequently published in November, 1979 (August and September data), March, 1980 (November, 1979, data) and July 1980 (March data).

It is on the "output side" of the EDB where emphasis on the "experimental" nature of the data bank has occurred. Each EDB Output Report has been a major revision of the previous report in terms of both format and content. Methods of presenting the data, level of detail, accuracy and validity, statistical significance, all of these, and more, are of concern to the Liaison Board members, and their concern is reflected in the high level of interest being expressed in the presentation of information from the EDB.

A Critical Design Review (CDR) of TRIP was held in April 1980. The CDR Committee, consisting of the TRIP Liaison Board representatives from the six participating properties and representatives from APTA, UMTA, and TSC, reviewed the past 24 months of TRIP activity; assessed TRIP benefits; listened to each participant's position on TRIP; and concluded that TRIP should be continued. It was further concluded that TRIP cannot be properly evaluated without 12 to 18 months of additional EDB experience.

The CDR recommendations impacted Phase I of the TSC TRIP Implementation Plan as follows:

- The operation and refinement of the RRV EDB by DRC with three major assemblies from 10 series of vehicles from 6 properties will be continued for an additional 21 months (15-month EDB operation and refinement with an additional 6-month EDB operation and merge transition period);

- The establishment and operation by TSC of an EDB for buses will begin during Phase I by monitoring a sample of assemblies from a limited number of buses.

Participation and interest in, as well as potential benefits from, Phase I indicate that TRIP EDB users (operating properties, consultants, Federal Government, and suppliers) want factual information from TRIP and are relying on TRIP's large quantity of readily available maintenance data to provide timely reports of equipment replacement experience.

Pending a favorable decision from the final Phase I CDR, Phase II will start a full-scale merged RRV and Bus TRIP Data Bank. It will be established and put on line starting with the transfer of data from the RRV and Bus EDBs. The number of equipments initially monitored will be small, but as the capability expands, additional equipments will be monitored until failure data on all vehicle components are contained in the data bank.

A CDR of Phase II can then be performed to determine if Phase II accomplished its goals and if Phase III is justified. Phase III is envisioned as the expansion of the Data Bank and equipment monitored to cover UMTA responsibilities in Fare Collection, ATO/ATC, and track and structures. As other transportation equipments are incorporated, the TRIP Data Bank will become the UMTA National TRIP.

These Guidelines will continue to be revised as the TRIP Data Bank is refined and improved to reflect the latest procedures and uses of this system. As new examples of the use of information generated by the Data Bank are provided, they will be included in this document to assist participants in the use of TRIP and the information which it produces.

1.3 REFERENCES

The following reports, issued by the Dynamics Research Corporation (DRC), collectively describe the development of the TRIP Experimental Data Bank. Except for references (5) and (6), below, these are "draft" reports which document the progressive development of the EDB. In some cases, the specific information contained in these reports has become obsolete. For the most part, however, the concepts remained valid as the EDB evolved and have been incorporated into one or more of the "final" reports, references (11) through (15), below.

(1) Report No. E-4852U - TRIP Task I Draft Report - (Data Bank/Source Investigation), December 18, 1978.

(2) Report No E-4894U - TRIP Task 2 Draft Report - "TRIP Data Bank Scope and Definition", January 18, 1979.

(3) Report No. E-4895U - TRIP Task 3 Draft Report - "Transit Vehicle Equipment Lists", January 18, 1979.

(4) Report No E-4896U - TRIP Task 3 Draft Report - "Reliability Equipment List Operating Procedures", January 18, 1980.

(5) Report No. R-284U - "TRIP Experimental Data Bank Acceptance Test Plan - Final", July 9, 1979.

(6) Report No. R-285U - "TRIP Experimental Data Bank Acceptance Test Procedures - Final", July 9, 1979.

(7) Report No. E-5234U - "TRIP Experimental Data Bank Program Maintenance Manual - Preliminary", October 19, 1979.

(8) Report No. E-5235U - "TRIP Experimental Data Bank User's Manual - Draft", October 19, 1979.

(9) Report No. E-5361U - "TRIP Generic Maintenance Action Codes", February 5, 1980.

(10) Report No. E-4998U - TRIP Task 4 Interim Report - "Rapid Rail Transit Vehicle Guidelines for the Operation and Use of the TRIP Data Bank", April 16, 1979. (NOTE: this is the draft report upon which this "TRIP Participants Guidelines" is based.)

The following reports also issued by DRC, are companion documents to this "TRIP Participants Guidelines". Collectively, these reports document the configuration, operation, use, application, and development of the TRIP Experimental Data Bank. This report is included in the following set of references to provide correspondence with the five themes mentioned above.

(11) Report No. R-337U - "TRIP Experimental Data Bank Program Maintenance Manual", September 30, 1980.

(12) Report No. R-338U - "TRIP Experimental Data Bank Operating Procedures Manual", September 30, 1980.

(13) Report No. R-339U - "TRIP Participants Guidelines", September 30, 1980.

(14) Report No. R-340U - "TRIP Reliability Demonstration Plan for Rapid Rail Vehicles", September 30, 1980.

(15) Report NO. R-341U - "TRIP Phase I Final Report for Contract Number DOT-TSC-1559", October 31, 1980.

SECTION 2 - TRIP DATA BANK OPERATIONAL OVERVIEW

The primary purpose of the TRIP Data Bank is to provide a computer-based system for the collection, analysis, and reporting of reliability information on transit equipment. Ultimately, TRIP will encompass all classes of transit equipment, including, for example: rail rapid vehicles; track and structures; wayside ATO/ATC; transit buses; automatic fare collection equipment, etc.

The development of the TRIP DATA BANK is being accomplished through an approach of phased implementation. The basic design of the system has been defined, and this design is being tested and enhanced through the operation of prototype system called the TRIP Experimental Data Bank (EDB). The EDB is accepting data on three rail rapid vehicle systems (doors and door controls; propulsion; and friction brakes) from five operating transit authorities (BART, CTA, NYCTA, PATCO, and WMATA). A sixth transit authority (GCRTA) will be added in 1981.

The purpose of this section of the "TRIP Participants Guidelines" is to provide an overview of TRIP Data Bank operation. This overview is written in the context of the Experimental Data Bank to describe the current operation. The concepts presented herein, however, apply directly to the fundamental design of the (full-scale) TRIP Data Bank.

A functional overview of the TRIP Data Bank (TDB) is shown in Figure 2.1. From a practical perspective, the objective of the TDB is to produce information in the form of periodic and special output reports. The data from which this information is derived is generated within the operation and maintenance environments of transit authorities.

Output reports are generally limited in number, type, and format; yet the variety and content of input data formats is limited only by the number of transit authorities that are supplying the data. It is, therefore, incumbent upon the Data Bank to provide the following functional capabilities:

- Standard Formatting - to prepare and transform the otherwise diverse data into a format which can be processed by "standard" software using "standard" techniques;

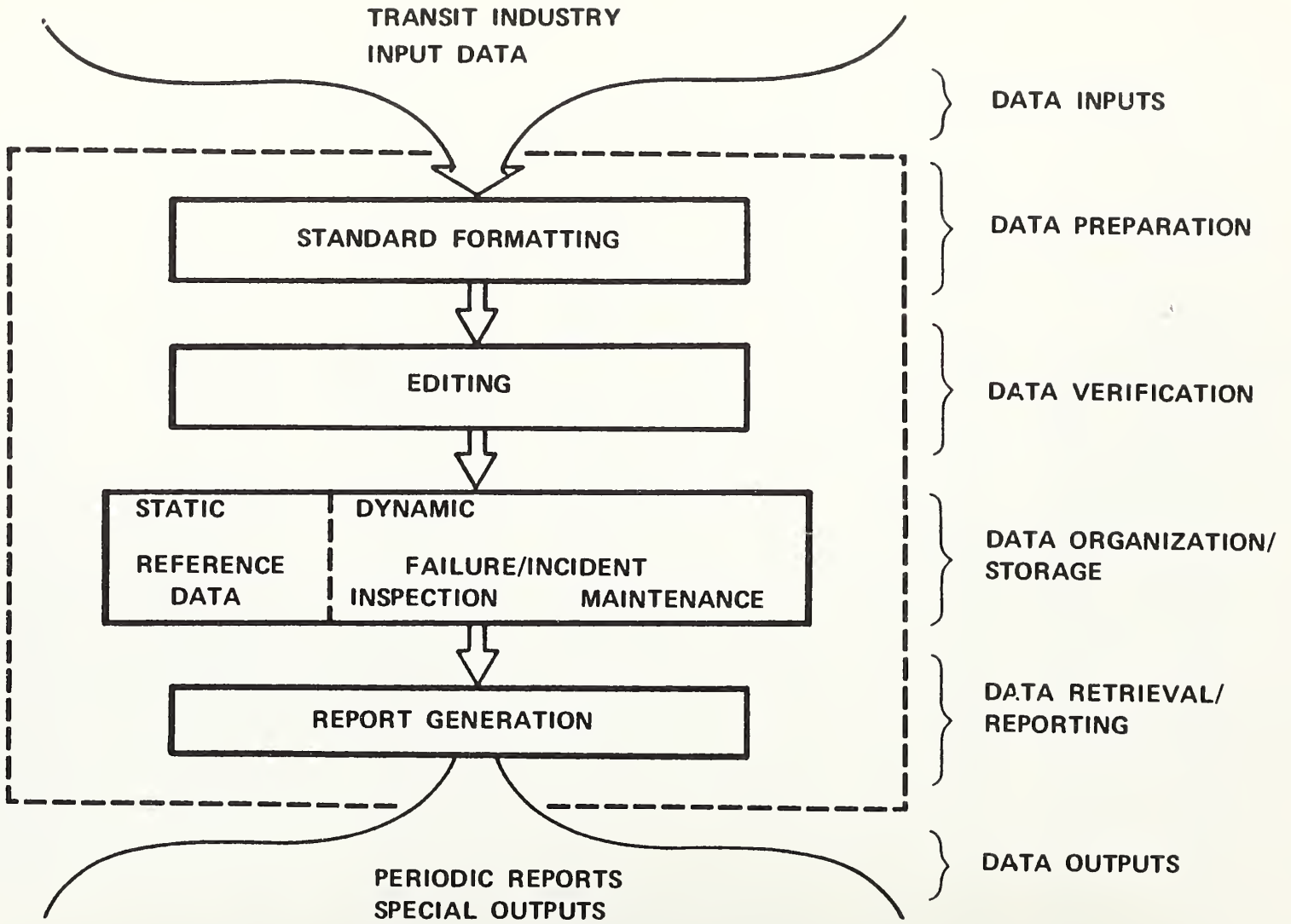


Figure 2.1 TRIP DATA BANK FUNCTIONAL OVERVIEW

- Data Editing and Verification - to ensure the accuracy and validity of the data being processed for Data Bank input;

- Data Organization and Storage - to provide maximum retrieval efficiency of voluminous data;

- Data Retrieval and Reporting - to provide for the production of routine reports, reference information reports, and special reports necessary for assisting and supporting the activities and needs of TRIP users.

The basic configuration of the TRIP Data Bank is shown in Figure 2.2. The "heart" of the Data Bank is the "Technical Integrated Data System" (TIDS), which is a data base management software system developed by DRC for the U.S. Navy. TIDS provides the functional capabilities of:

- Data Editing - final editing for syntax and content of the "standardized" data base input record;

- Data Compaction - reformatting the input record to eliminate unused character spaces and, therefore, conserve storage space in the data base;

- Data Base Update - adding new data, or deleting/modifying data already on the data base;

- Data Base Access - retrieving data from the data base and "externalizing" it from its compacted state into its original format.

The various transit authorities employ different methods of collecting and processing the data that they generate during the course of operating and maintaining their equipment. In order to accomodate this diverse data in the Data Bank, a set of TRIP Input Programs was developed to convert the incoming data from the unique, property-specific format to the standard format of the Data Bank. These programs provide the functions of:

- Data Entry - direct entry of data through a video display computer terminal from hard-copy forms;

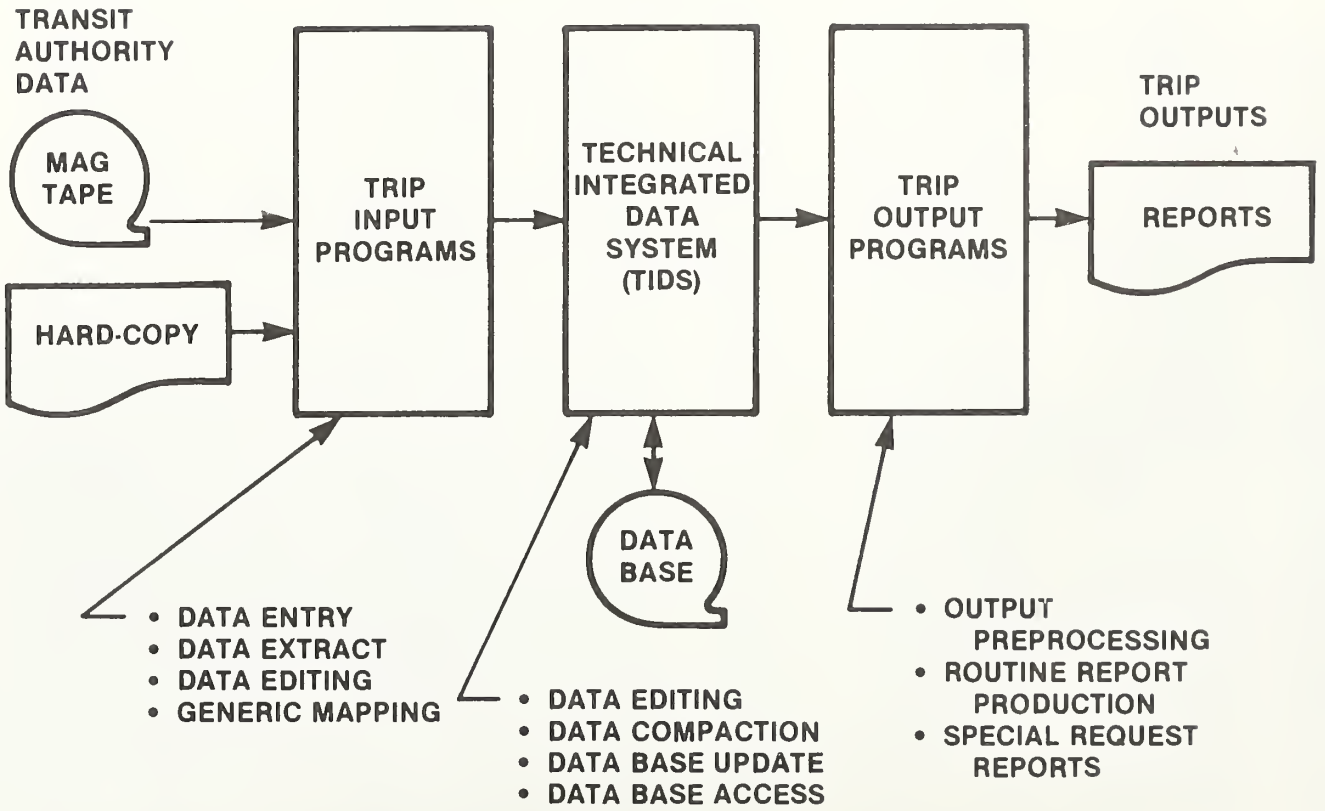


Figure 2.2 TRIP DATA BANK OVERVIEW

- Data Extract - selection of TRIP-related data from computer-generated, magnetic tapes of transit authority data;

- Data Editing - comparison of data elements with property-specific definitions, value ranges, etc.;

- Generic Mapping - conversion of the data record into the data base input record format and cross-referencing of selected data elements to standardized ("generic") TRIP equivalencies.

A set of TRIP Output Programs has also been developed which are tailored to the specific information needs of TRIP users. The TRIP Output Programs include software modules for:

- Output Preprocessing - for the purpose of performing preliminary analyses on the data which assess the quality, integrity, and validity of the data set being used for output report production;

- Routine Report Production - standard programs which produce the periodic reports published by TRIP;

- Special Request Reports - includes both generalized software systems for data base query and "customized" software.

A more detailed overview of the TRIP Experimental Data Bank for Rail Rapid Vehicles (RRV EDB) is presented in the following subsections. The concepts and procedures presented in this overview are directly transferable to the Bus EDB as well as the full-scale TRIP Data Bank.

2.1 DATA SUBMISSION

Two basic types of data are processed and stored in the TRIP Data Bank: "dynamic" data and "reference" data. Dynamic data includes transit vehicle operating and maintenance data and is used for the production of reliability information such as, maintenance rates and inspection intervals. Dynamic data constitutes the major percentage of data stored in the Data Bank.

Reference data is used for interpreting the reliability information and includes:

- Transit System Configuration;
- Transit System Route Configuration;
- Transit System Route Operating Information;
- Vehicle Type Description Information;
- Vehicle Type Specification Information;
- Vehicle Type Configuration Information;
- Vehicle Equipment Specification Information.

Reference data is extracted from route maps, equipment specifications, operation and maintenance manuals, parts catalogs, etc., and is transcribed onto data forms. These forms are prepared as a cooperative effort between the transit propery and TRIP operating staff, and the data from the completed forms is entered into the Data Bank.

All submissions of dynamic data to the Data Bank are transmitted by either the U.S. Postal Service or private carriers. There are two basic media in which dynamic data is submitted to TRIP:

- Hard-copy forms - includes maintenance forms; vehicle logs; mileage reports; inspection reports; operations logs; etc.;
- Magnetic Tapes - includes any or all of the above types of hard-copy data, and may be generated by the transit property computer facility, or by a computer service bureau from transit property data cards.

Hard-copy data is retained by the Data Bank for archival storage and is not returned to the source. Transit properties submitting hard-copy data, therefore, send "expendable" copies of the forms. Magnetic tapes, on the other hand, are copied onto TRIP tapes and returned to the source after processing.

2.2 DATA ENTRY

The input processing of TRIP data is accomplished in two stages: data extraction and conversion from the transit property format into a standard, "non-generic" format; and, cross-referencing of selected data elements to "generic" equivalents and reformatting of the data record into the "generic" data base input format. The first stage of data entry is shown in Figure 2.3.

The Hard-Copy Data Entry Program provides the capability to enter data directly from the hard-copy forms. This program, through a video display computer terminal, allows the operator to enter data into blank "forms" which are displayed on the screen. Several "forms" are available within the program so that all types of dynamic and reference data can be entered in this manner.

Some editing is performed by the Hard-Copy Data Entry Program to ensure that "required" data elements have been entered (e.g: property ID; date; etc.) and alphabetic characters have not been entered into numeric fields (e.g car number; date; etc.).

In the Experimental Data Bank, all data from CTA and WMATA and mileage data from PATCO are submitted on hard-copy forms. Special editing criteria have therefore been incorporated into the Hard-Copy Data Entry Program for these properties to assist in the process of "screening out" data which does not pertain to the three vehicle systems being monitored by the EDB (doors and door controls; propulsion; and friction brakes).

Magnetic tapes that are submitted to TRIP fall into two classes: tapes which are compatible with (i.e.: can be directly read by) the TRIP host computer (Honeywell 66/20); and, tapes which are not compatible with the host computer. A "compatible" tape (e.g.: from BART and PATCO) is copied to a TRIP tape by a utility Tape Copy Program which is designed around the attributes of the particular tape being copied. A "non-compatible" tape (e.g. from NYCTA), before it is copied, is processed by a Tape Converter Program to convert its contents into the proper code set and format.

After the copy is made, the data (now on the TRIP copy of the property tape) is processed by a Data Extraction Program which performs the same functions as the Hard-Copy Data Entry Program. A separate Data Extraction Program is

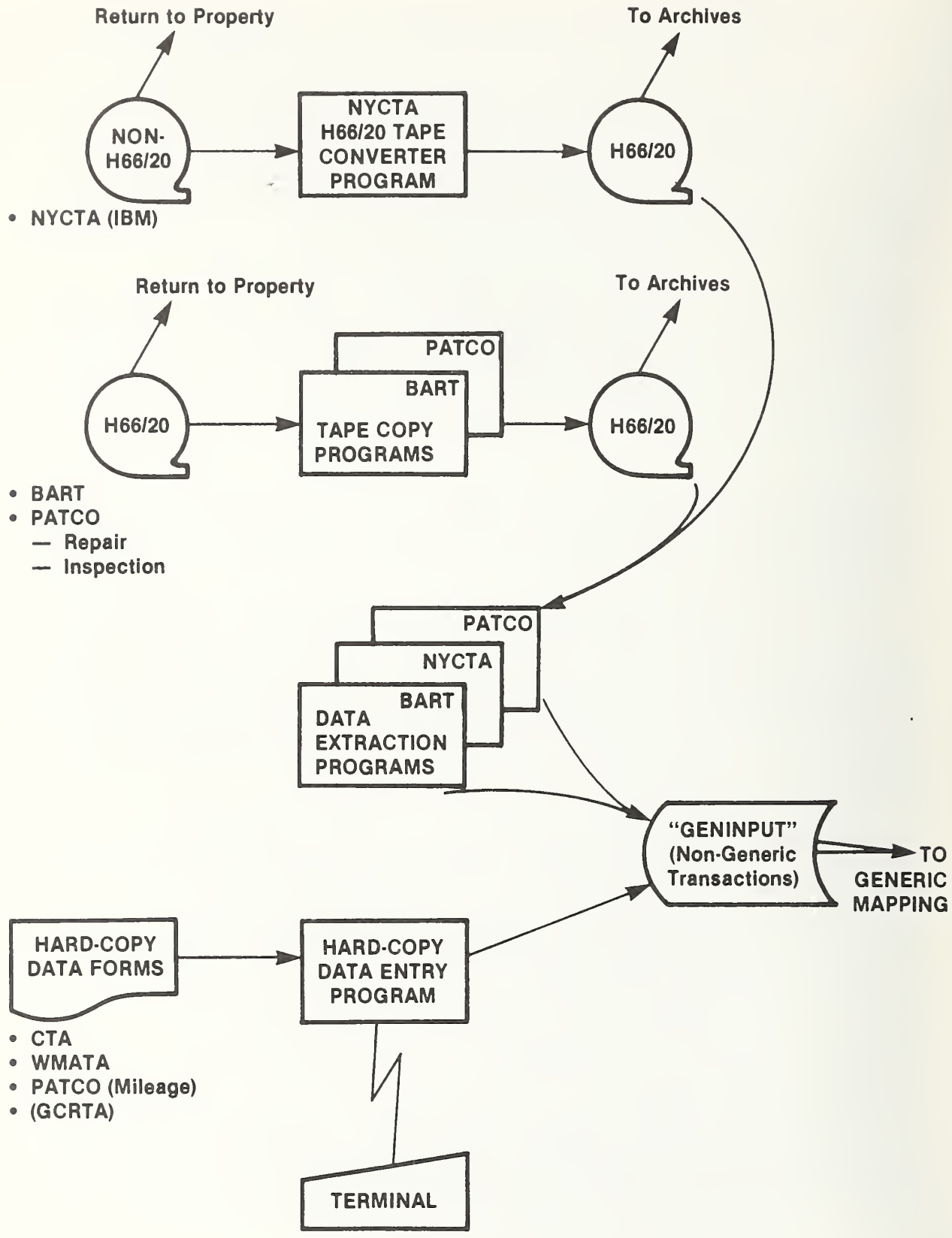


Figure 2.3 RRV TRIP DATA ENTRY

prepared for each property, and each program is tailored to the specific format and content of the data contained on the tape.

The records that have been prepared by the Hard-Copy data Entry Program and Data Extraction Programs are output to a common file of "non-generic transactions". This file ("GENINPUT") is the "input file" for the second stage of data entry which is shown in Figure 2.4.

The Generic Mapper Program: 1.) reads the "non-generic transactions" (new data) from the "GENINPUT" file and the "non-assignable transactions" (previously failed input records) from the error file; 2.) assigns corresponding TRIP generic codes to certain data elements; 3.) reformats each record into a "generic transaction"; and 4.) outputs the completed records to a magnetic tape for later input to the data base management system, TIDS.

The format of a typical data base record is shown in Figure 2.5. The first six elements of a data base record are called the "key" and are common to all data base records, regardless of type. The "key" serves as an "address" and defines the data base location where the record will be stored. Beyond the "key" are the individual data elements which characterize the type of record.

Twenty-two (22) unique record formats have been defined in the TRIP EDB: four (4) for dynamic data; and eighteen (18) for reference data. Each format is classified by RECORD TYPE ("key" element). The SEQUENCE "key" is used to identify variations of RECORD TYPE. The combination of RECORD TYPE and SEQUENCE thus defines a unique record format which is used to store a particular kind of data. Table 2.1 lists the 22 TRIP records by RECORD TYPE and SEQUENCE. The content of each record is shown in Appendix A, hereto.

The generic mapping process is accomplished by a series of three table look-up routines. The first is to construct the Generic Serial Number (GSN). For a typical Repair Record (D01), this is accomplished by reading "Property ID" and "Car Number" from the non-generic transaction and using these elements as "search keys" to find the "Vehicle Series ID" from the Fleet Tables (Compare Figures 2.4 and 2.5). These three elements are combined to form the GSN for the record "key".

The next step is to assign the Generic Part Number (GPN) which is a twelve-character code used to provide a common, computer-recognizable "name" for components of

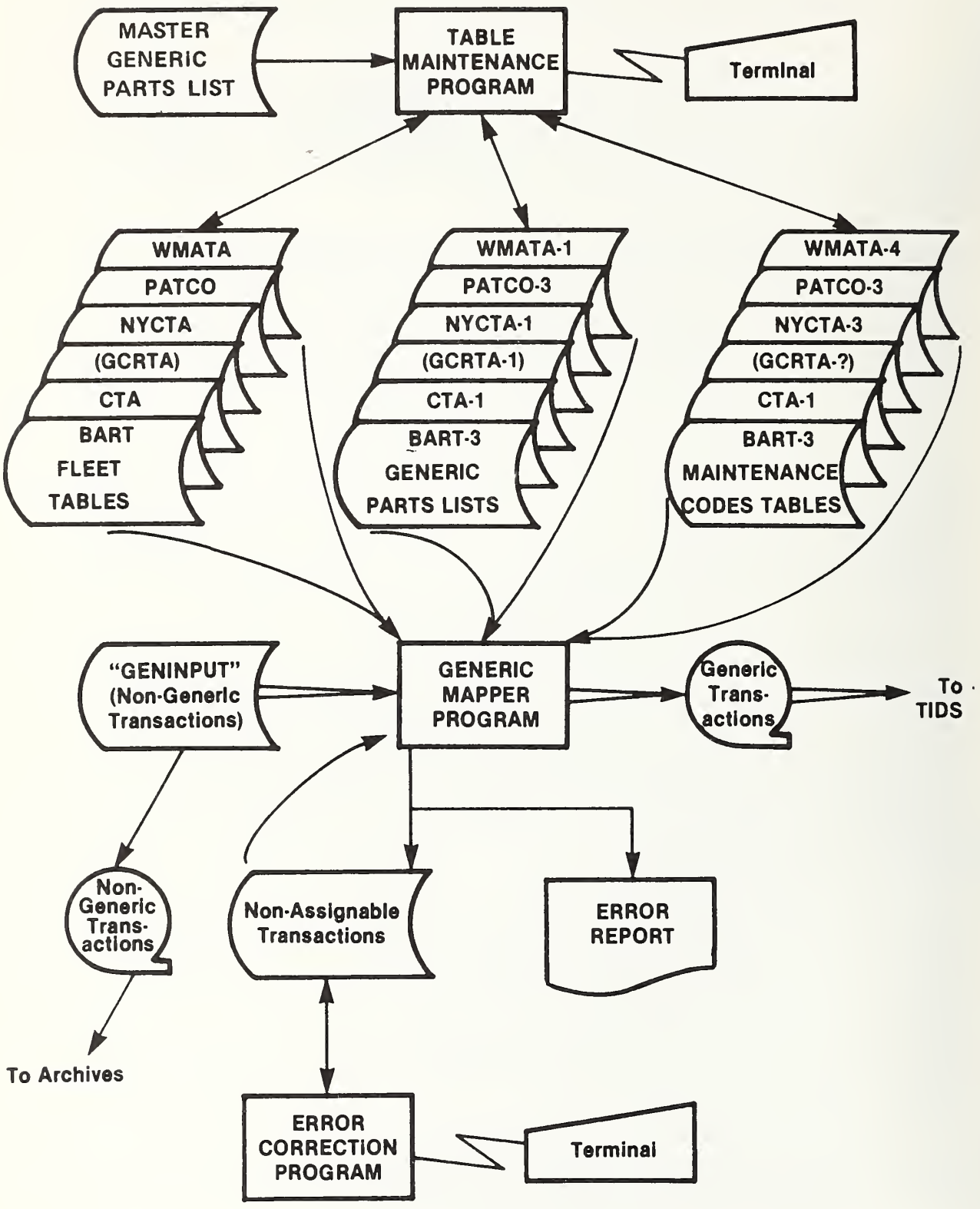


Figure 2.4 RRV TRIP GENERIC MAPPING

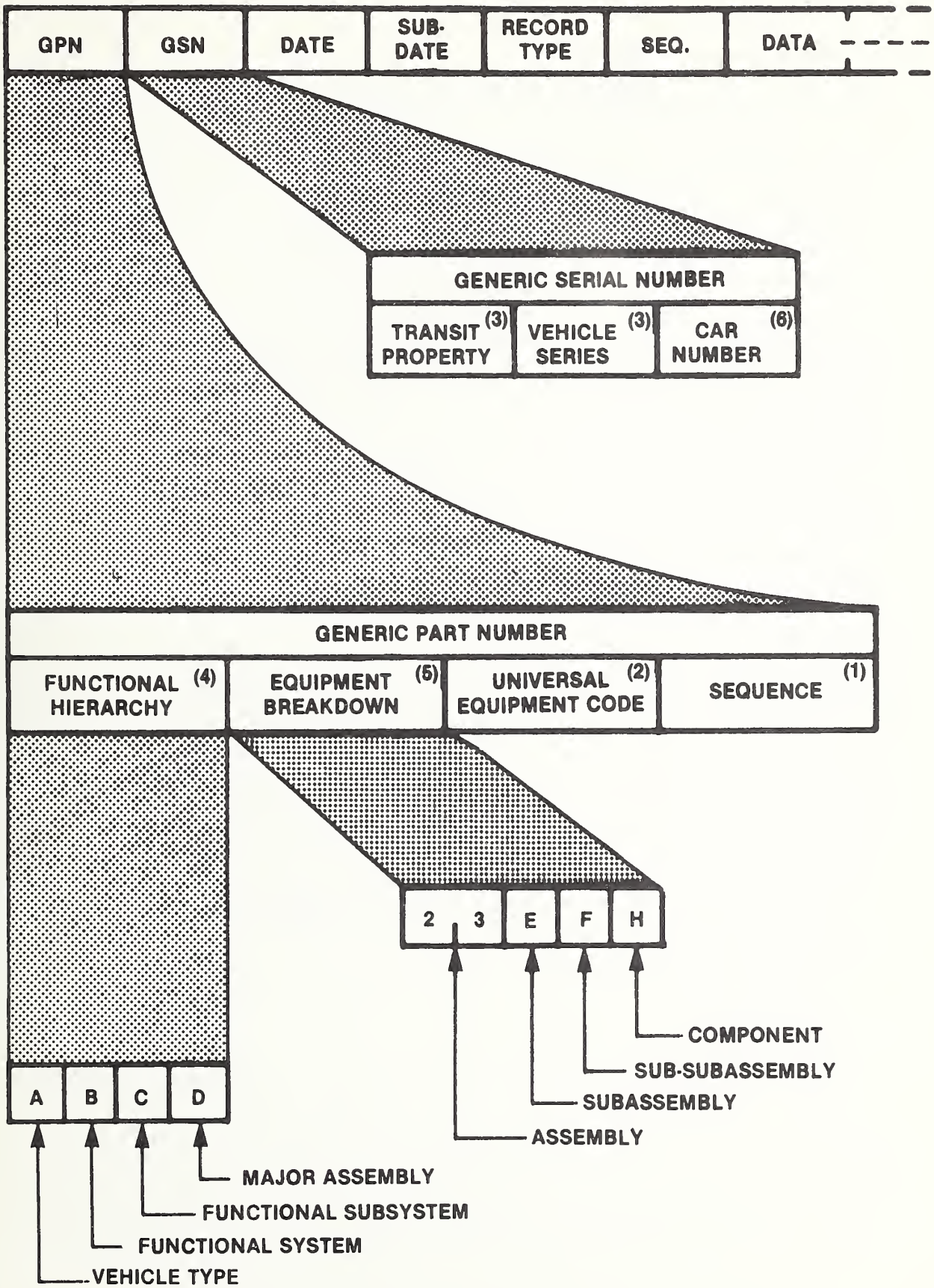


Figure 2.5 TRIP DATA BASE INPUT RECORD FORMAT

TABLE 2.1 TRIP DATA BANK RECORDS

RECORD TYPE	SEQUENCE	DESCRIPTION
		DYNAMIC DATA RECORDS
A	01	Utilization
C	02	Scheduled Maintenance
D	01	Unscheduled Maintenance - Repair
D	02	Unscheduled Maintenance - S/N
		REFERENCE DATA RECORDS
I	01	System Configuration
J	01	Route Configuration
K	01	Route Operating Information
L	01	Fleet Data
M	01	Specification Data
N	01	Door System
N	02	Air Comfort System
B	03	Communications System
N	04	Auxiliary Electrical System
N	05	Propulsion System
N	06	Friction Brakes System
N	07	ATO/ATC - Cab Signal System
N	08	Truck & Suspension System
N	09	Coupler & Draft Gear System
N	10	Power Collection Equipment System
N	11	Car Body & Structures
O	01	Hardware Configuration Data
O	02	Hardware Specification Data

similar function. The GPN is structured to provide classification of the component by the function it performs, the location of the component within the vehicle, and classification of the component by type. Each of these three elements of the GPN structure can be used individually or in combination to sort and analyze the data within the Data Bank. The fourth element of the GPN, as shown in Figure 2.5, is used to distinguish between multiple application of the other three elements.

A Generic Parts List (GPL) is a cross-reference table of transit property part numbers versus Generic Part Numbers. A GPL is prepared for each vehicle series being monitored by the Data Bank. The "Property ID" and "Vehicle Series ID" elements of the GSN are used by the Generic Mapper Program to select the appropriate GPL. The property part number from the non-generic transaction is used as a "search key" to find the GPN for the record "key".

The final step in the generic mapping process is to assign Generic Maintenance Action Codes when present (D, C, and O RECORD TYPES only). Maintenance action codes describe the four basic steps in the maintenance process:

- Symptom Codes - describe operational problems usually experienced by the vehicle operator;
- Defect Codes - describe reasons behind the observed symptom which are usually discovered during inspection, trouble-shooting, testing, or maintenance activities;
- Repair Codes - describe actions taken to correct known defects or to treat observed symptoms;
- Test Codes - describe actions taken to disclose a defect or to validate a repair.

A Maintenance Codes Table is a cross-reference table of transit propery maintenance action codes versus Generic Maintenance Action Codes. A Codes Table is prepared for each property that is supplying data to the Data Bank. The "Property ID" element of the GSN is used to select the appropriate Maintenance Codes Table. The transit property maintenance action codes from the non-generic transaction are used as "search keys" to find the appropriate generic codes.

If the table look-up routines are successful in assigning generic values, the record is reformatted into a "generic transaction" which combines the data elements of the "non-generic transaction" with the generic values. Referring to Figure 2.5, the GPN and GSN elements of the record "key" are assigned the values derived during the table look-up processes. The DATE "key" is derived from the date contained in the "non-generic transaction" which, for a repair record (D01), would be the "maintenance date" (See Appendix A). The SUBDATE "key" is initially set to zero (0).

If the mapping process fails a table look-up routine (e.g. car number, property part number, or property code not found on the table), the entire "non-generic transaction" is written out to an error file of "non-assignable transactions" along with an error "flag" which is set to "E". The record, along with a message describing the error, is also written out to an "Error Report" for examination by the TRIP operating staff. An Error Correction Program enables the TRIP personnel to correct, set to retry (error flag = "R"), or delete records from the error file. All records which have been corrected and/or set to retry are recycled through the Generic Mapper Program during its next execution.

After the entire "batch" of new records have been read from the GENINPUT file and corrected records from the error file have been mapped and reformatted, the Generic Mapper Program sorts and rearranges the records into a work file. Each record is compared with the next record in the sorted sequence. If two or more records in the sequence are exact duplicates, the first record is retained and the duplicate records are "dropped" and written to the "Error Report". Such duplications are thus treated as multiple submissions, and only the first submission is retained as valid data.

If the record "keys" (first six elements in Figure 2.5) of two or more records are duplicate, yet the succeeding data elements differ by at least one field, the SUBDATE "key" of the subsequent records is incremented by one (reset from "0" to "1", "2", etc.) to establish a unique record "key" for each record. After all records have been processed from the sorted work file, the Generic Mapper Program outputs the entire "batch" of records to the "generic transactions" tape which is the input source for the data base management system, TIDS.

It should be noted that primary control for the generic mapping process is derived from the various cross-reference files that are used in the table look-up routines. Once

established, the contents of these files are relatively stable. Some changes do occur, however, as cars are retired from service due to accident or fire, maintenance codes are redefined, or new equipment is introduced. A Table Maintenance Program has therefore been incorporated into the TRIP Input Programs to provide the capability of modifying, adding, and deleting information contained in these tables.

Ideally, required changes are made known to TRIP personnel by the transit property before they appear in the data. Most of the required changes, however, are "discovered" by TRIP personnel when a new code, part number, or vehicle number fails generic mapping. Failures of this type are confirmed with the transit property before the tables are updated to ensure that it is an actual change rather than a data error.

2.3 DATA STORAGE

Data storage is accomplished through the Technical Integrated Data System (TIDS), shown in simplified form in Figure 2.6, which utilizes a Data Base Dictionary to provide the final data verification function prior to data base entry. The Dictionary itself is the master format or description file for data being input, stored or retreived from the data base. To provide this master format control capability, the Data Base Dictionary contains:

- Complete descriptions of all data base input record types, including:
  - Data elements in each record type;
  - Sequence of data elements in each record type;
  - Field length of all data elements:
- Complete listing of all valid Generic Part Numbers being accepted into the Data Bank (i.e., Master Generic Parts List);
- Complete descriptions of all record types as they appear on the data base.

All input to TIDS is first processed by the Historical Data Subsystem. This module catalogs all data base

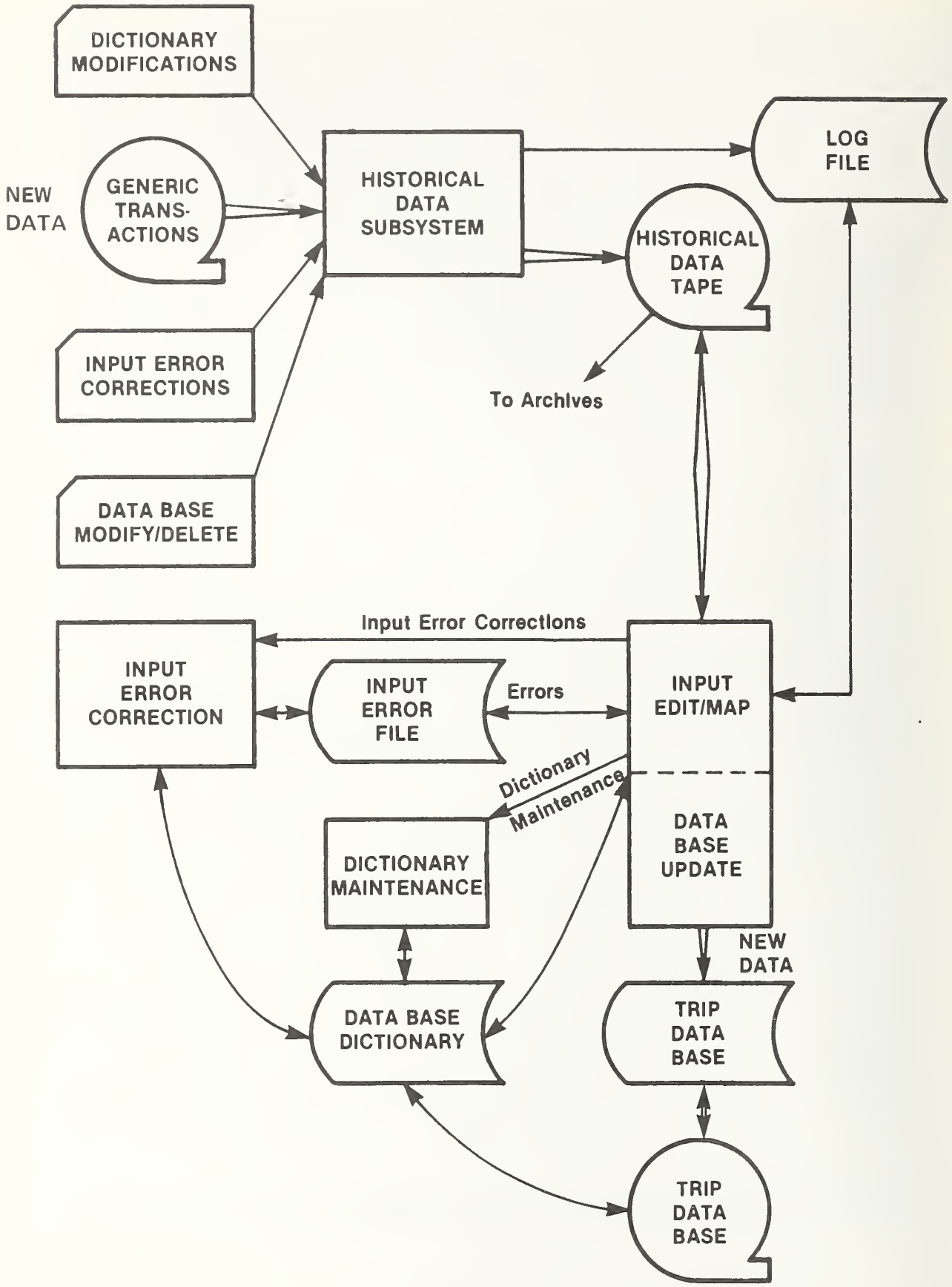


Figure 2.6 TRIP DATA BASE UPDATE

submissions, be they: new data ("generic transactions" tapes), data base modify/deletes, input error corrections, or Dictionary modifications, and merges these submissions onto "historical data" tapes. The "log file" is used by succeeding modules of TIDS to direct the flow of data through the system based upon the type of submission.

The accuracy and validity of the data which is ultimately stored on the data base is an important factor in the operation of the Data Bank. Because of this importance, error checking takes place in two modules.

The first editing module checks to determine if the data input format is recognized by the Data Dictionary. Recognition is based on the presence of a description of the input data format on the Dictionary and also upon the verification of the Generic Part Number as one which is being monitored. This module also checks each data field to ensure that it contains the proper type of data (numeric versus alphabetic).

The second level of editing resides in the module that actually updates the data on the data base. Once the input data has been checked for proper format and content, the "key" elements (Generic Part Number, Generic Serial Number, Date, Subdate, Record Type, and Sequence) are compared to data already stored on the data base in order to avoid duplicate entries. If a duplicate "key" is found on the data base, the individual data elements are compared with the "new" record. If they, too, are duplicate, the "new" record is "dropped" and no data base update occurs. If the individual data elements of the "new" record are different from those already on the data base, the "new" is written to the "input error file" so that it can be examined by TRIP personnel. Following verification of the record, an "input error correction" would be submitted to TIDS by TRIP personnel to modify the SUBDATE "key" of the "new" record so that the record will be added to the data base on the next "pass" through the Data Base Update module.

Because of the sizes of the TRIP Data Base and Data Base Dictionary, these files are stored on a magnetic tape. This off-line storage technique provides automatic protection of the system because the Data Base and Dictionary are read in from the "old" tape before processing and output to a "new" tape after processing. The "old" tape thus provides a backup copy of the Data Base and Dictionary in case of machine failure.

The focal point of TRIP is its Data Bank which is used to store all static and dynamic data and is the source for generating all routine and special outputs and reports. The Data Bank which is used for TRIP is termed an "integrated" data base based on the following characteristics:

- All data is stored in one central storage location allowing easy access to any data item;
- The data base consists of different types of data all logically related by Generic Part Number and in chronological order to permit rapid and efficient retrieval.

The centralized storage of all data permits the efficient analysis of different types of data and standardization of data content. For example, reference and dynamic data are stored side-by-side in the data base by Generic Part Number. This storage method permits analysis of dynamic data based on various reference data parameters such as route mileage.

The Data Bank is logically arranged in chronological order by Generic Part Number and Generic Serial Number. This logical arrangement of the data can be viewed as providing a "filing cabinet" of data with a "folder" for each unique serialized part. All "folders" are in part number sequence and, for a given part, all serialized occurrances are grouped together. The data in the "folder" is in most-recent to least-recent chronological order for each serial number to provide quick access to more recent data. This data organization method provides an historical account of the application, utilization, and maintenance of each part number.

2.4 DATA RETRIEVAL

The retrieval of information from the TRIP Data Base is accomplished by two modules of the Technical Integrated Data System (TIDS), as shown in Figure 2.7. The Selective Data Retrieval subsystem is used to subset the data base by a date range. This is done by searching on the DATE element of the record "key" (see Figure 2.5). For the production of routine output reports (see Section 2.6), a three-month date range is specified to abstract the data set necessary for a one-month report.

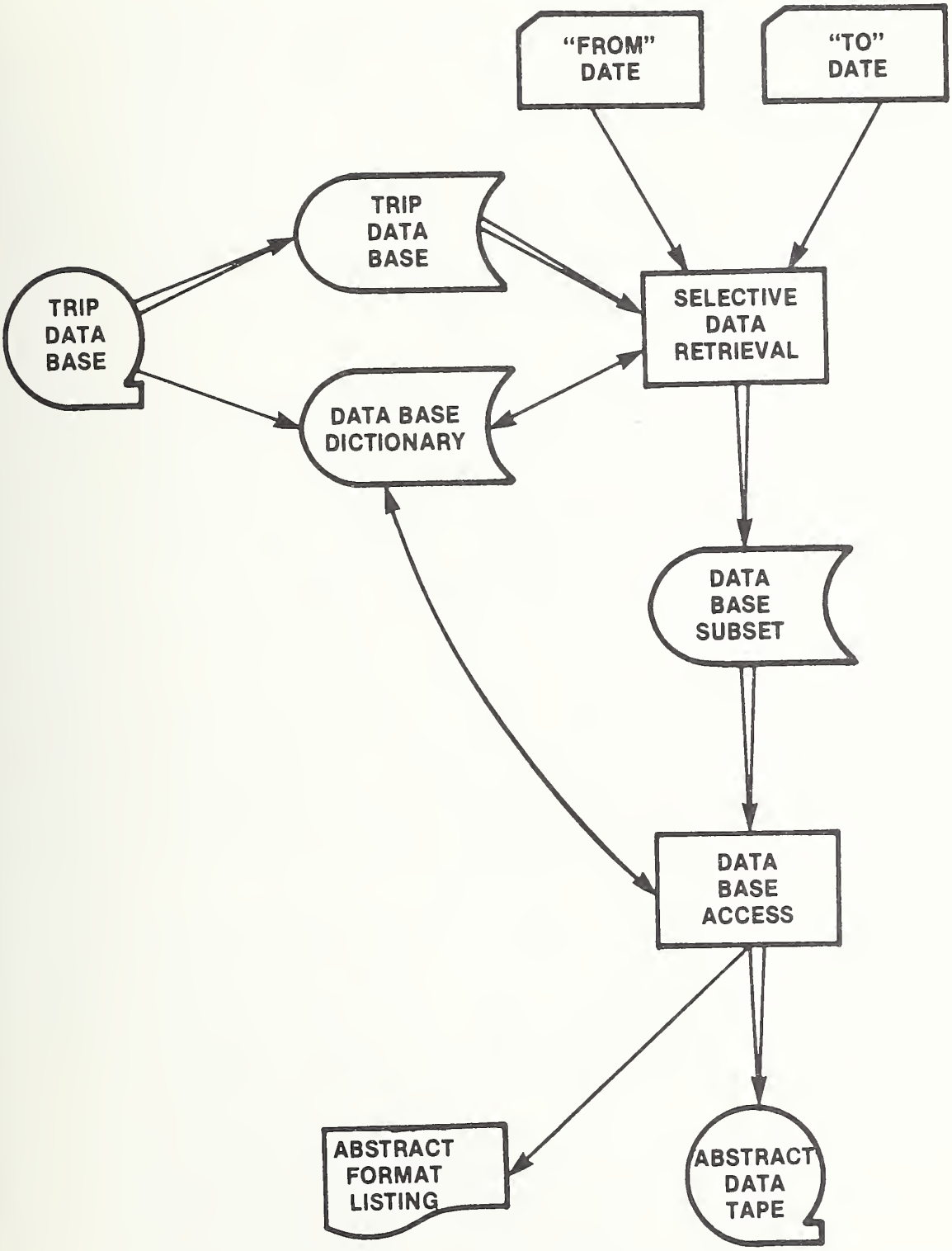


Figure 2.7 TIDS DATA RETRIEVAL/ACCESS

The Data Base Access subsystem provides the capability to access the data contained in the data base by discrete data elements. The "names" of all data elements, by record type, are contained in the Data Base Dictionary. By specifying data "names", the data required to produce an output report can be extracted (copied) from the data base along with the record "key" in which the data elements are contained. The Data Base Access subsystem copies all occurrences of the data elements into a work file which is then output to an "Abstract Data" tape. The Data Base Access subsystem also produces an "Abstract Format Listing" which contains a complete description of the content and arrangement of the "Abstract Data" tape.

A standard list of data "names" is normally used for producing the "Abstract Data" tape. This list contains the "names" of all data elements contained in the dynamic data records (see Table 2.1 and Appendix A), and causes the Data Base Access subsystem to reconstruct these records in their entirety. This "standard" tape can thus be used for the production of both routine output reports and special reports which require access to only dynamic data.

2.5 OUTPUT REPORT PRODUCTION

Two basic types of output reports are produced by the TRIP Data Bank: routine (i.e.: periodic) reports; and special reports. (These reports are described in detail in Section 5.0 of this manual.) Routine reports are further divided into monthly reports and annual reports.

Monthly reports include summaries by vehicle series, transit property, and industry of the utilization, inspection, and unscheduled maintenance of transit vehicles. These reports present their information in both tabular and graphical formats. There are three types of annual reports: summaries of the monthly reports; detailed performance reports of certain major equipment assemblies and critical components; and reference information reports which describe the types of equipment and operating environment which are being monitored by the TRIP Data Bank. A special report, under the broadest definition, is any report that is not a routine report of the TRIP Data Bank.

Special reports are produced in response to requests from participants and users of TRIP. Special reports may be either "one-shot" reports in that the "question" is asked

only once and only one "answer" is required, or they may be repetitive in that they may support, for example, a test program of finite duration. The major distinction between special and routine reports, therefore, is that special reports are prepared for a limited rather than general audience.

The generation of output reports from the TRIP Data Bank is shown in Figure 2.8. In order to minimize processing costs, an "Abstract Data" tape is created (see Section 2.4) which contains a subset of the entire data base. The extent of the subset is based upon the range of dates to be included in the analysis and the type of information that is to be reported.

For routine (monthly) report production, the "Abstract" tape contains three months (the month being reported, plus the one before and the one after) of dynamic data (utilization, inspection, and unscheduled maintenance records). The Preprocessor Program computes the period mileage for each car and audits the inspection and maintenance data records pertaining to the month (period) being reported. The period mileages and set of inspection and maintenance records are output to a "monthly details" file which is used as input for the Routine Report Programs.

The programs which produce the routine output reports are of three general types:

- "Detail" programs which compute inspection intervals and maintenance rates on a car-by-car basis and output the results to file containing the same information for the preceding 24 months:
- "Summary" programs which produce the vehicle series, property, and industry tabular summary reports;
- "Graphics" programs which produce histographs and trend plots from the "24-month Rolling File".

Special reports are usually produced directly from an "Abstract" tape, however, the "24-Month Rolling File", "Monthly Details" file, or the data base itself could also be used as input. Most special reports are produced by a utility software system which is resident on the TRIP host computer. This "Report Generator" provides the functions necessary for sorting, selecting (screening), reformatting,

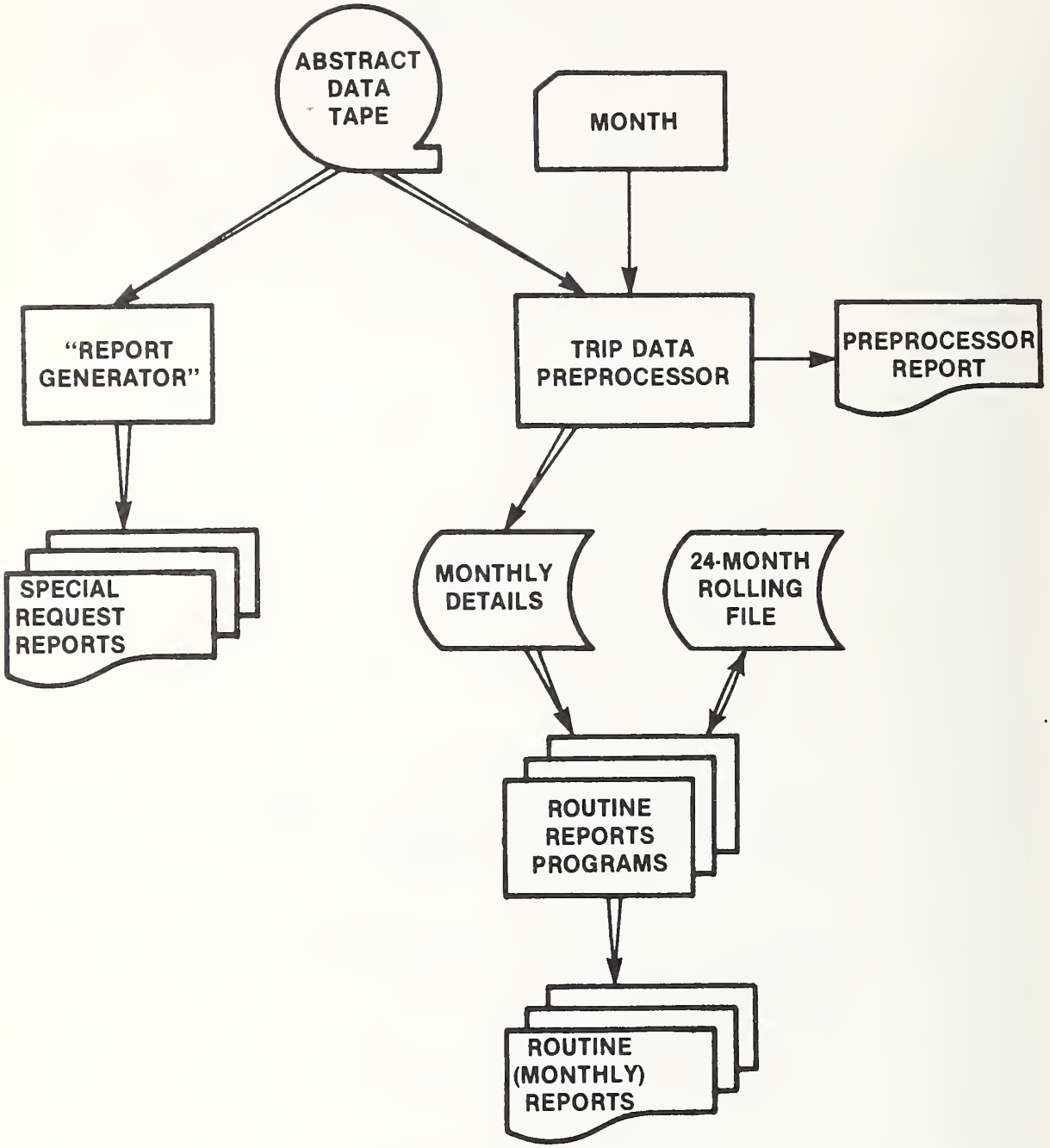


Figure 2.8 TRIP OUTPUT REPORT PREPARATION

and displaying (i.e: output to a line printer) the data. Basic analyses are possible with the "Report Generator", however, the more complex special reports also utilize other subroutines and programs.

Procedures for requesting a special report from TRIP are contained in Section 5.4 of this manual. Modifications to existing routine reports and the addition of new routine reports may also be requested of TRIP. These procedures are contained in Section 5.2.

2.6 ERROR CORRECTION AND DATA VALIDATION

The flow of data through the TRIP Data Bank is shown in Figure 2.9. Transit properties (shown in figure, but other sources, too) submit data to TRIP on both hard-copy forms and magnetic tapes (see Sections 2.1 and 4.0). All data receipts are monitored and cataloged by TRIP personnel to ensure that the Data Bank remains current and routine reports can be produced in a timely manner.

The data is prepared by TRIP personnel and entered via either the Hard-Copy Data Entry Program or a magnetic tape Data Extraction Program (see Section 2.2). The data is then cross-referenced (mapped) to the standard ("generic") values. Any error or failure to map that is encountered is reviewed by TRIP personnel. Obvious problems are corrected by the TRIP staff based upon their experience with the data and knowldege of the data source. When necessary, however, the source of the data is contacted in order to determine the disposition of unique data problems.

The majority of the data entering the TRIP Data Bank undergoes two or more stages of automated processing before reaching the data base management system, TIDS (see Section 2.3). Therefore, very few data errors are encountered during the final editing of the data prior to updating the data base. Errors which do come out of TIDS are usually caused by duplication of a record "key" when multiple records on the same component clear Generic Mapping at different times. Such "errors" are corrected by TRIP personnel by modifying the SUBDATE "key" (see Section 2.2).

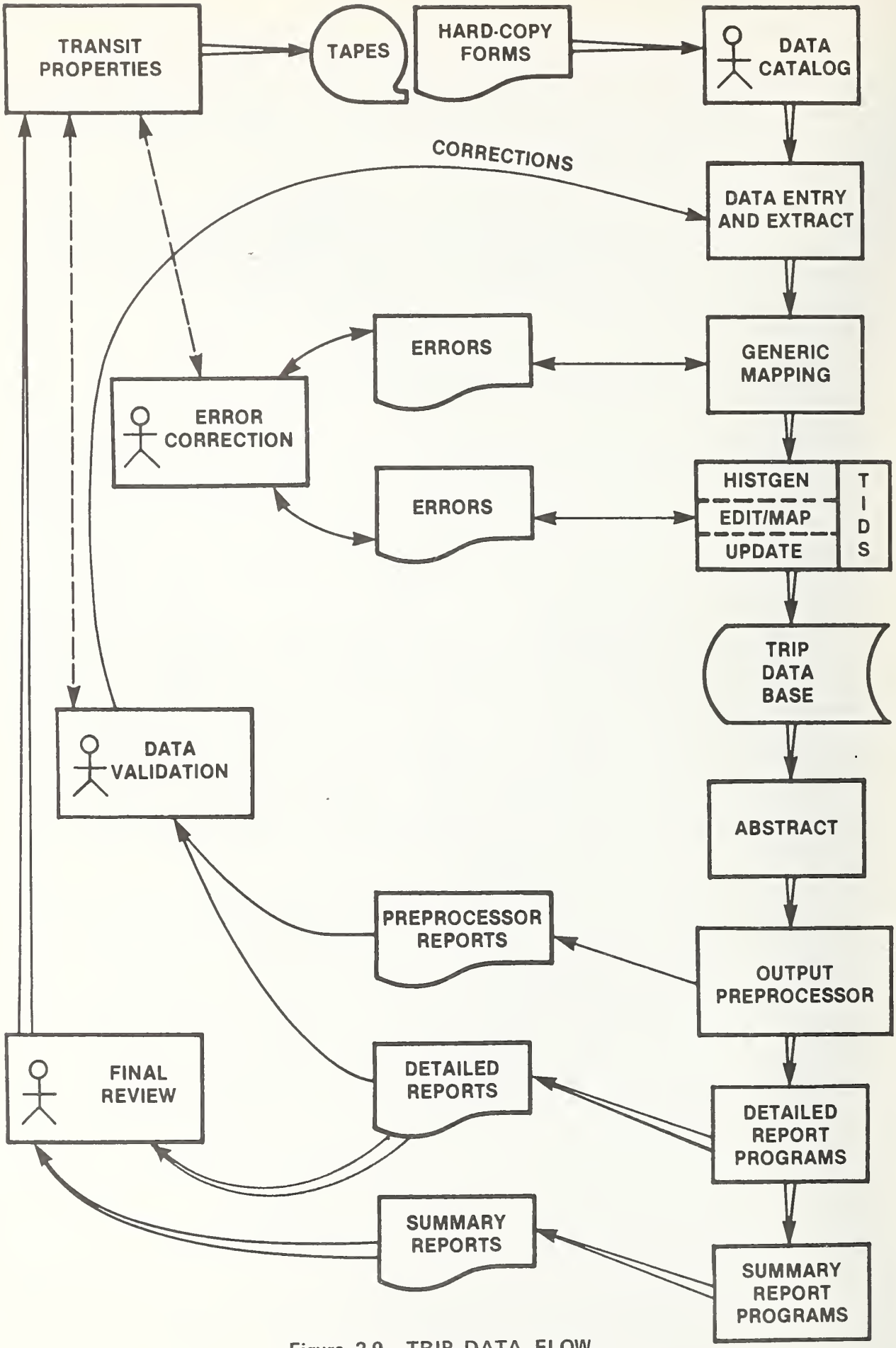


Figure 2.9 TRIP DATA FLOW

The input half of the data flow cycle is completed when the data is actually placed on the TRIP data base. The output half of the cycle begins with retrieval of data from the data base and creation of the data base "Abstract" (see Section 2.4). Figure 2.9 depicts the procedure for routine report production; however, functionally similar procedures are followed for the production of special reports.

The Output Preprocessor Program performs the initial analysis of the data by auditing the record set and computing period mileage. The Preprocessor reports provide TRIP personnel with detailed descriptions of errors encountered during program execution. The computation of period mileage discloses most of the data problems, which range from not having enough data to compute the mileage to coming up with an invalid mileage (e.g.: less that zero). The audit of the record set by car number, when compared in the Preprocessor Program to the property fleet tables, discloses car numbers for which no data at all has been submitted by the property.

An attempt is made by TRIP personnel to resolve the data problems by comparing the suspect data base records with the "as-received" copy of the property data. This procedure will occasionally reveal a data entry error from hard-copy forms. In the majority of cases, however, the error is in the "as-received" data, and the problem must be referred back to the source.

The Detailed Report Programs compute inspection intervals and maintenance rates by vehicle. The detailed reports from these programs are reviewed by TRIP personnel to determine the validity, or "reasonableness", of the statistics. Questions resulting from inconsistencies in the reported information are referred back to the source for either validation or correction.

After the detailed information has been validated, updated detailed reports and summary reports are produced for publication. These reports are reviewed by TRIP personnel as a final step in validating the analyses. Summary reports are then distributed to all participants and users of TRIP, and detailed reports on their data are issued to the data sources.

The flow of data through the TRIP Data Bank is, therefore, a "closed loop" which begins and ends at the data source. The unique aspect of TRIP is that it accepts data in whatever form and format the data source utilizes for its own purposes. Once this diverse data "clears" the Data

Entry and Extract Programs, however, the data has been transformed into "standard" formats which can be processed using "standard" techniques which are not source-dependent. Standardized formatting and processing, combined with "generic" (i.e.: standard) cross-referencing of functionally similar part numbers and operationally similar maintenance actions, have provided the transit industry with its first practical "tool" for assessing its own performance and reliability on a national basis.

SECTION 3 - TRIP DATA BANK CAPABILITIES AND USE

The TRIP Data Bank is an integrated, industry-wide source of transit reliability information. Transit equipment operators and manufacturers may voluntarily submit "field", "bench", and "design" data to TRIP in order to build a common base from which equipment reliability and performance can be assessed on a national basis. The features and capabilities which have been incorporated into the TRIP Data Bank to support this industry objective are described in the following subsections.

3.1 DATA INPUT AND STORAGE

The TRIP Data Bank has the capability to accept data in whatever form and format the source of the data utilizes for its own purposes. This means that participation in TRIP does not impose special procedures or additional burdens upon the data collection activity.

The backbone of the TRIP data entry process is a thorough understanding and knowledge of the format and content of the data being supplied to the Data Bank. This knowledge enables TRIP personnel to cross-reference the individual elements of the data supplied to the corresponding data elements that are collected and stored in the TRIP Data Bank. Procedures are then developed for each data source to cross-reference their data to the TRIP record formats.

For data supplied on hard-copy forms, the cross-referencing procedures are implemented manually in the form of instructions to TRIP data entry personnel for entering data through a video display computer terminal. A computer program displays blank "forms" on the screen into which data from the hard-copy forms is entered.

Data sources which utilize a computer for data processing and storage provide magnetic tapes (or other computer-readable media) of their data to TRIP. In these cases, the data cross-referencing procedures are implemented as a computer program to provide automated processing of the incoming data. A separate data extraction program is prepared for each data source and is tailored to the

specific attributes (format and content) of the data being supplied.

The TRIP Data Bank utilizes an integrated data base for data storage. The term "integrated" is derived from the following characteristics of the data base:

- All data is stored in one central storage location allowing easy access to any data item via the data record "key" (or, "label");
- The data base contains a wide variety of data types, including reference, operating, inspection, and unscheduled maintenance data;
- The various types of data are all logically related through the Generic Part Number (GPN) and Generic Serial Number (GSN) elements of the record "key";
- All data is stored in reverse chronolocigal order by GPN and GSN to provide rapid access and efficient production of routine reports.

3.2 DATA RETRIEVAL AND ANALYSIS

Primary access to the data stored in the TRIP Data Bank is provided by the record "key", which represents the "address" on the data base where the record is stored. The record "key" for the TRIP Data Bank contains six elements (refer to Figure 2.5 in Section 2.2), four of which can be used, singly or in combination, as "search keys" to extract data from the data base. These "keys" are:

- Generic Part Number (GPN) - a standardized code used to identify equipment by function;
- Generic Serial Number (GSN) - identifies:
  - Property;
  - Vehicle Series;
  - Car Number;
- Date - derived from the data contained in the data (e.g.: maintenance date);

(NOTE: The subdate "key" is meaningless by itself and is used only in combination with the Date "key" to establish a unique record identity for multiple transactions on the same GPN on the same Date.)

- Record Type - identifies the type of data (e.g: inspection, utilization, reference, etc.).

(NOTE: The Sequence "key" is meaningless by itself and is used only in combination with the Record Type "key" to define the record format and content to the data base management software system.)

Data may also be accessed by specifying an individual data element name (see Appendix A). This approach is not as efficient as using the "key" and is therefore used only when necessary to access data for a special analysis or report. The preferred and efficient, approach to data retrieval is to access a "block" of data consisting of complete records by specifying ranges (or specific values) on the record "keys". This subset of the data base, because of its reduced volume, can then be efficiently processed to extract the specific information of interest.

The routine periodic reports produced by the TRIP Data Bank provide the basis for the assessment and comparison of the reliability performance of various vehicle and equipment types. Comparison of TRIP output data for equipment and vehicles in different applications and environments is made possible through the use of uniform analysis and reporting methods for all data being collected from every source. The continued production of routine reports also permits the assessment of both trends and seasonal variations in reliability and performance.

The algorithms used to produce the routine reports were developed during the implementation and operation of the TRIP Experimental Data Bank (EDB), a prototype of the (full-scale) TRIP Data Bank. The objectives of these algorithms were to provide standard analytical techniques which could be applied to all data, regardless of the data source, and the simultaneously provide as broad a perspective as possible of equipment reliability and performance within the transit industry. From this "industry perspective", certain limiting factors were encountered which directly effected the development of the algorithms used to produce the routine output reports on TRIP dynamic data. The more significant limiting factors are summarized below:

- Most, but not all, transit operators monitor and periodically record vehicle mileage; the others record operating hours. This led to the selection of mileage as the basis for determining inspection intervals and maintenance rates. Operating hours are multiplied by a conversion factor (average system speed in miles per hour, as estimated by the property) to make the conversion to mileage.

- Reporting periods are different at each property. "Period mileage", therefore, is defined only in the local context. For this reason, "life cumulative mileage" is recorded as "utilization data" in the TRIP Data Bank and is used to compute mileage for the Data Bank "period", which is a calendar month.

- The degree of detail contained in a maintenance record varies with each property from only four data elements (car number, repair date, part number, and repair code) on up (see Appendix A). These four are, therefore, the "least common denominator" and basis from which the routine reports are produced.

- Part numbering approaches used by the various transit operators to identify equipment for data collection and analytical purposes vary considerably in the level of component detail. The most detailed approach stops just short of nuts, bolts, and washers (called "miscellaneous hardware"). The least detailed approach identifies only critical components and functionally similar classes of equipment within major subsystems. Routine reports, therefore, are produced by aggregating the maintenance data to the vehicle system level.

The TRIP Data Bank can access and analyze the information contained in the data base by virtually any individual or combination of data elements as defined in Appendix A. Limitations on the ability of the Data Bank to analyze its data are imposed, not by internal constraints, but by the number of data elements provided by each data source, and by the depth of detail and logical content of each data element that is provided.

The TRIP Data Bank was not designed to replace the daily data collection, storage, and analytical activities at

an operating transit property. The logistics involved in assimilating transit data on a national basis impose an 8-week time delay in the routine reporting cycle that precludes the usefulness of TRIP as a substitute for a property's own automated maintenance information system. This 8-week delay is proportioned as follows:

- 2-3 weeks, following the close of the month being reported, for the data sources to "close out" their data;
- 1-2 weeks to assemble the data and transfer (mail) it to the Data Bank;
- 2 weeks for data entry, error correction, and data validation;
- 2 weeks for report production, publication and distribution to participants and users.

On average, data from an individual source is input to the data base and available for access and analysis within one week of being received by the Data Bank. About 50-60 percent of the 8-week routine reporting cycle goes to the acquisition and transfer of the data by the source. Once the data is on the data base, however, the turn-around time for special report production is limited only by the volume of data to be analyzed and complexity of the algorithms and processes involved.

3.3 SPECIAL SERVICES

In addition to producing routine reports, the TRIP Data Bank can also provide a limited number of special reports in response to requests for information from TRIP participants and users. These special reports may potentially draw upon the full range of static and dynamic data being stored in the Data Bank and typically present information described as follows:

- Retrieval and analysis of data being stored, but not routinely reported (e.g.: maintenance codes correlation);

- Simultaneous retrieval and presentation of both static and dynamic data in a single report for the purposes of comparison and interpretation (e.g.: equipment replacement rates versus operating requirements for this equipment);

- Presentation of routine report information in a different format or covering a different reporting period (e.g.: plotted output rather than tabular; report covering "seasonal" period).

Special reports may be requested by TRIP users to support detailed analyses or investigations. These reports may also be requested in order to provide additional insight into data being routinely reported. (See Section 5.4 for procedures to be followed when requesting special reports.) An important feature of the TRIP Data Bank is the integration of all data types, both static and dynamic, into a single storage system. The integrated form of this data base will permit the efficient and comprehensive retrieval and analysis of all data being collected.

When a particular special report is required on other than a one-time basis, arrangements can be made through the sponsoring agencies of TRIP to provide the repetitive report as a special service of the Data Bank to the particular user. (The procedures for requesting special services are described in Section 5.4.) Two examples of this type of special service are:

- Product improvement program support, where prototype equipment may be installed on a limited number of vehicles and require special monitoring and reporting during the period of evaluation;

- Warranty assurance program support, where unusually detailed data must be collected, stored, and analyzed for an extended, but finite, period.

3.4 USES OF TRIP DATA BANK INFORMATION

An important feature of the TRIP Data Bank is the integration of all data types, both dynamic and reference, into a single storage system. This integrated form of the data provides for efficient and comprehensive retrieval and

analysis of all data being stored. Users to which this data, and the routine and special output reports of the Data Bank, can be applied include, but are by no means limited to:

- Reliability assessment of an individual vehicle or equipment type based upon information reported concerning unscheduled maintenance activity, including component replacements, indicating either actual or suspected failures, and the maintenance actions associated with this hardware, which do not result in component replacement, but nonetheless required the expenditure of labor;

- Comparison of reliability-related information for vehicles and/or equipment being operated by different transit properties to highlight specific factors, including vehicle utilization, maintenance policies, and equipment application, which may be influencing the reliability of this hardware;

- Comparison of utilization and scheduled maintenance activity by vehicle type as possible indicators of demands being placed on the equipment in terms of operation, and the approach being taken by maintenance organizations to minimize unscheduled maintenance through periodic inspection and preventive maintenance;

- Comparison of vehicle and equipment reliability-related information from reporting period to period to highlight trends and possible degradation in hardware performance;

- Determination of "baseline" reliability values for vehicles and equipment based upon the reporting of information covering an extended time period (e.g.: annual) which may be used for the development of equipment specification criteria or as the basis for product improvement programs.

SECTION 4 - TRIP PARTICIPATION AS A DATA SOURCE

A fundamental premise upon which TRIP is based is that operators and manufacturers of transit equipment are currently generating data relative to the production, operation, and maintenance of that equipment. The fundamental objectives of TRIP are, therefore, to:

- Collect this information, which is already available, through the voluntary participation of the sources of this data;
- To provide uniform procedures for the acquisition, storage, and analysis of this data;
- To make this information available to all facets of the transit industry for the mutual benefits of information exchange and technological improvement.

This section of The Guidelines, therefore, describes the role of a data source for the TRIP Data Bank, and includes descriptions of:

- The types of information (reference data) that are required both to support the processing of input data and to assist in the interpretation of the information contained in the data;
- The types of data that are collected by and stored in the TRIP Data Bank;
- Recommended procedures for submitting data to TRIP;
- Participation cost considerations versus potential benefits.

4.1 THE ROLE OF A DATA SOURCE

TRIP came into existence because the need for comprehensive transit reliability information was recognized by the transit industry. Members of the transit industry united, under the sponsorship of the Federal Government, to establish a national reliability Data Bank. TRIP continues to exist because individual contributors have recognized its value as a forum of information exchange and technology sharing. The success of TRIP has come about through the willingness of its data sources to contribute, voluntarily, their data to this industry program.

The primary role of a data source is to supply data to the Data Bank. Beyond this, however, each source takes an active role in the continuing refinement and enhancement of TRIP through its representative on the TRIP Liaison Board. The purpose of the Liaison Board is to provide guidance and direction for TRIP Data Bank operation and enhancement. This function is performed during periodic work sessions when Liaison Board members meet to review and critique program documentation and output reports.

The Liaison Board representative acts as the point of contact between the data source and TRIP staff members. The Liaison Board representative need not be a "resident expert on all topics", but should have a relatively high degree of familiarity with organization and operation of the data source and know to whom a question should be directed.

The Liaison Board representative acts as coordinator for the preliminary meetings between the data source and TRIP staffs. These first meetings are particularly important, if an efficient and timely "start-up" is to be achieved, because it is there that the bulk of reference information is transferred. It is from this reference information that the TRIP staff prepares the Data Bank to accept data from the new source.

Once data submission has been established as a routine procedure, the data source is encouraged to actively participate in TRIP through its Liaison Board representative. Such participation would include:

- Attendance and participation of the representative in periodic work sessions of the Liaison Board;

- Review and critique of program documentation and output reports by engineering, operations, and maintenance supervisors, as well as by the Liaison Board representative;

- Contribution, through the representative, of ideas and recommendations for continued TRIP development and enhancement.

A final responsibility of the Liaison Board representative is to keep the TRIP operations personnel informed of all changes in part numbers, maintenance codes, and other factors which effect the data being submitted to TRIP. If new equipment or vehicles are to be introduced at the property, TRIP personnel should be given as much advance notice as possible in order to prepare the Data Bank to accept data on these items.

The role of a TRIP data source, therefore, extends beyond that of being a supplier of prodigious amounts of codified commentary on the operation and maintenance of transit equipment. TRIP relies upon the interests and insights of its participants to maintain the Data Bank as a meaningful "tool" for determining equipment performance and reliability within the transit industry.

4.2 TYPES OF INFORMATION REQUIRED BY TRIP

Transit operators generally produce and collect the same basic types of information relating to the operation and maintenance of their equipment. Included in this information is data on: revenue service incidents, periodic inspections, and unscheduled maintenance. It is this "dynamic" data that TRIP solicits from its sources, and from which TRIP derives its reliability information. Before dynamic data can be stored in the TRIP Data Bank, however, the system must be "initialized" to accept it, and this process requires certain information from the new source.

Several steps are involved in initializing the TRIP Data Bank to accept data from a new source. The first step is for the TRIP staff to acquire a thorough understanding of the types, format, and content of the data being generated, collected, and stored at the source. In addition, the TRIP staff must become familiar with:

- The equipment for which data will be reported;
- The numbering system used to identify the equipment in the data (part numbers, hardware ID's, etc.);
- Use and definitions of maintenance codes (symptom or incident, failure or defect, repair or corrective action, test or inspection, etc.) that will appear in the data.

The bulk of this reference information is transferred through discussions between the source and TRIP staff during the initial familiarization meeting(s). Sources of this information include:

- Parts catalogs;
- Operations and maintenance manuals;
- Stock catalogs;
- Maintenance data system codes books;
- Data collection forms (e.g.: Inspection Reports, Maintenance Discrepancy/Correction Forms, Vehicle Service reports, Work Orders, etc.);
- Vehicle rosters.

The other type of reference information that is solicited during the familiarization meeting(s) is used, not for initialization of the Data Bank, but for interpretation of the information that will be produced from the data. This type of reference information describes the operating characteristics, policies, and environment of the equipment as well as maintenance policies and procedures. All of these are factors which effect the performance and, therefore, reliability of the equipment. Sources of this information are:

- Operating Rules & Procedures Manuals;
- Maintenance Procedures Manuals;
- Operating Schedules;
- Inspection Schedules;
- Route and system configuration data (maps, etc.);
- National Weather Service Climatological Reports.

After familiarization with the new data source and collection of reference information, the TRIP staff begins the process of initializing the Data Bank. Referring back to Figures 2.3 and 2.4 (see Section 2.2), the steps in initialization process are:

- Compare the source data formats with the TRIP data record formats (see Appendix 1) and identify the data elements to be cross-referenced;
- Develop cross-referencing procedures:
  - For hard-copy data, convert these procedures into instructions for TRIP data entry personnel;
  - For computer-readable data, convert these procedures into a Data Extraction Program and, if necessary, develop a Tape Copy or Converter Program;
- Develop and load the Fleet Table which contains the car numbers, by vehicle series, for which data will be supplied by the source;
- Develop and load the Generic Parts List(s) which cross-references the part numbers (hardware ID's etc.) used by the data source to Generic Part Numbers (see Appendix B);
- Develop and load the Maintenance Codes Tables which cross-reference the maintenance action codes used by the data source to Generic Maintenance Action Codes (Symptom, Defect, Repair, and Test);
- Add the new data source code (Property ID) to the data entry and output report programs, and modify the industry summary reports to include the new source.

After the "mechanics" of initializing a new data source on the TRIP Data Bank are complete, the remaining step is to establish a nominal schedule by which the source will be submitting dynamic data. This information is required in order to integrate the new data into the established routine of data entry, error correction, and routine output report production.

4.3 TYPES OF DATA STORED BY TRIP

TRIP collects and stores a complete range of data types and formats which are currently being generated by transit properties, thereby imposing no additonal data generation requirements on these data sources. TRIP utilizes this predefined data to produce its outputs and reports.

The two general types of data which are solicited for input to the TRIP Data Bank:

- Reference Data;
- Dynamic Data.

Reference data is information which describes the configuration, characteristics, and operation of a transit system, vehicle type, or equipment on a vehicle type. This information is used to initialize the Data Bank to accept data from a source, and to interpret and understand the outputs and reports generated by TRIP. Uses of reference information include: interpretation of differences in reliability values by vehicle type based upon passenger loads and operating requirements; or interpretation of reliability values for a class of equipment based upon the characteristics and intended application of each equipment type in that class.

Reference data is stored in summary form in the TRIP Data Bank. The Data Bank records that store reference data are listed in Table 2.1 (see Section 2.2), and the record formats are shown in Appendix A. Sources of reference data include:

- Transit System Route Maps;
- Station Platform and Power Substation Separation Data;
- Vehicle Maintenance Manuals;
- Operating Schedules;
- Car Assignment by Routes;
- Vehicle Specifications.

Reference data is also used for the processing of dynamic data for input to the Data Bank. Reference data covering cars of a specific vehicle type at each property, part number information for components and equipment on a

type of vehicle, and maintenance action code information, are used to "translate" input data into a common TRIP Data Bank format, and for the assignment of generic "keys" to identify and organize groups of stored data.

Reference data sources of information which are used for input processing of dynamic data, including the assignment of Generic Part Numbers, Generic Serial Number, and Generic Maintenance Action Codes include:

- Property Parts Books;
- Manufacturers Equipment Catalogs;
- Property Code Books;
- Car Compliment by Vehicle Type.

Dynamic data consists of information covering the operation and scheduled and unscheduled maintenance of transit vehicles and equipment. Dynamic data provides the basis for determining revenue service reliability and maintenance requirements for transit vehicles. Dynamic data types include: vehicle utilization; vehicle inspection types and frequency; and vehicle unscheduled maintenance types and frequency.

The major quantity of data stored by the TRIP Data Bank is dynamic data describing the revenue service operation, inspection, and repair of transit vehicles. Sources of dynamic data include:

- Car operator Reports;
- Equipment Defect Reports;
- Car Inspection Reports;
- Car Maintenance Reports;
- Car Maintenance Logs;
- Operation/Transportation Logs;
- Car Mileage Records;
- Component Repair Forms.

4.4 SUBMITTING DATA TO TRIP

Most reference data appears in either books, maps, or charts. This information is normally transferred to TRIP personnel during the initial familiarization meetings and is hand-carried back to the Data Bank facility. Submissions of

supplemental reference data are transmitted by either the U.S. Postal Service or private carriers, depending upon volume and weight.

Submissions of dynamic data to the TRIP Data Bank are also transmitted by either the U.S. Postal Service or private carriers. There are two basic media in which dynamic data is submitted to TRIP:

- Hard-copy forms - includes maintenance forms; vehicle logs; mileage reports; inspection reports; operations logs; etc.;
- Magnetic tapes - includes any or all of the above types of hard-copy data, and may be generated by either the transit property computer facility, or by a computer service bureau from transit property data cards.

4.4.1 Supplying Hard-Copy Data

TRIP has the capability of accepting and processing hard- copy data as input to the Data Bank. The labor involved in preparing this data for input to the Data Bank is provided by the TRIP operations staff, so that data sources need only supply copies of the information which they are already producing in their organization. The major requirement for hard-copy data is that it be legible.

Basic procedures have been set up to input hard-copy data to the TRIP Data Bank (see Section 2.2). These procedures are tailored for the specific application based upon the descriptions of the data that are supplied as reference information. In order to tailor these procedures for the specific information to be supplied by an individual data source, the following information is necessary:

1. Description of the data types to be submitted, including:
   a. Data form types (e.g.: utilization; inspection; maintenance);
   b. Description of how and when these forms are used in the maintenance process.

2. Description of the content of each data type, including:

   a. Data fields on each form;

   b. Identification of required and/or related fields.

3. Description of the content of each data field, including:

   a. Type of data (e.g.: alphabetic, numeric);

   b. Range of numeric data;

   c. Definition of codes;

   d. Definition of abbreviations and/or special terms.

The frequency of data submission is dependent primarily upon the volume of the data, although one-month intervals are preferred. For submission via the U.S. Postal Service, "First Class" mail, a single submission should not exceed about one ream (five pounds) of high-speed copier paper. The major consideration is the strength of the package. Whether data submissions are made weekly or monthly, a regular routine should be maintained.

Hard-copy dynamic data is not returned to the source, but is retained as a permanent record of the submission. (Reference information sources, however, - manuals, catalogs, etc. - are returned after the data has been extracted from them.) The data submitted to TRIP, therefore, should be duplicate and expendable copies. The only requirement imposed by TRIP on the otherwise voluntary submission of hard-copy data is that it be legible.

4.4.2 Supplying Data on Magnetic Tapes

The preferred media for data submission to TRIP is, of course, the magnetic tape. This computer-readable data can be readily processed and input to the TRIP Data Bank with minimum human intervention.

Two basic approaches are currently being employed by TRIP participants to submit data on magnetic tape from their automated data systems. In the first case, a small, "business" computer is used to collect and store operating and maintenance data. Input to the computer is by punched cards, and the only output device is a printer. Each input card represents a complete maintenance (or inspection) transaction. These cards are set aside after being input to their own computer and are periodically sent to a local computer service bureau where they are "loaded" onto tape. The magnetic tape is transferred directly to the TRIP Data Bank by the service bureau, and the cards are returned to the source. Utilization data is submitted as a hard-copy mileage report which shows life cumulative mileage by car number. This report is produced periodically for their own accounting purposes. An "extra" copy is run off specifically for TRIP.

The second case involves a large mainframe computer having a full complement of peripheral devices. Typically, the larger computers are used to operate a comprehensive maintenance management information system which includes an integrated data base of operating and maintenance data. A computer program is prepared by the TRIP participant to access their data base and extract the data that is to be input to TRIP. This program is run each month (usually mid-month) to extract the previous month's data and load it onto a tape. This tape is then transferred to the TRIP Data Bank.

Regardless of how the tape is created, TRIP personnel execute a Tape Copy (or Conversion) Program and a Data Extraction Program to input process the data. These programs are tailored to the specific attributes, format, and content of the tape based upon the descriptions provided as reference information. A separate familiarization meeting for the participant's data processing personnel and TRIP staff is usually conducted to exchange information concerning the structuring of the data tape. The following reference information is necessary in order to prepare the Copy (or Conversion) and Extract Programs:

1. Definition of data as recorded on computer-readable magnetic media, including:

    a. Computer hardware/software system from which data was generated;

    b. Magnetic medium characteristics, including:

- labeling;
- density and recording rate;
- blocking;
- code set (BCD, ASCII; EBCDIC);

c. Order and organization of data as recorded;

2. Definiton of the types of data to be submitted by a data source including:

   a. Data groups (e.g.: utilization; inspection; unscheduled maintenance; component repair);

   b. Data elements for each data type (e.g.: fields in each data type "record");

3. Definition of the content of each data element, including:

   a. Type of data (e.g.: alphabetic; numeric; both);

   b. Range of numeric data;

   c. Definition of codes;

4. Hard-copy duplicate of the first sample of data supplied on magnetic media to be used for a one shot verification of the accuracy of TRIP input processing. Subsequent submissions need not include a hard-copy duplicate of the data.

In order to ensure that the information contained in the Data Bank is of the highest accuracy, it is particularly important that the following data elements be clearly identified:

- Source submitting data (i.e.: transit property ID);
- Vehicle type and/or car number associated with each data type;
- Type of data on a record-by-record basis (e.g.: utilization; inspection; unscheduled maintenance);
- Data and/or reporting period associated with each data type (e.g.: date of maintenance; date on which mileage was recorded or computed).

The preferred frequency for the submission of dynamic data to TRIP is on a monthly basis, or an equivalent period which is already used for reporting by a data source (e.g.: every four weeks). Magnetic tapes can be safely mailed in padded shipping bags. The outside of the bag should clearly identify the contents with the phrase: "MAGNETIC TAPE - DO NOT X-RAY", or equivalent, to prevent accidental alteration of the data.

All magnetic tapes are returned to the source after the data has been copied onto a TRIP Data Bank tape and verified. Tapes are always returned via "First Class" mail and insured for $50.00 to defray expenses in the event of damage.

4.5 COST CONSIDERATIONS

Consideration of participation in TRIP will invariably include an assessment of the costs of participation. These costs can logically be divided into two kinds:

- Costs associated with system operation;
- Costs associated with data submission.

Operating costs of the TRIP Data Bank are currently being assumed by the program sponsor, the Urban Mass Transportation Administration (UMTA). For the most part, data submission costs are borne by the various participants as a form of implicit co-sponsorship.

Data submission costs can be estimated by examining the labor and other resources required by the participant to provide input data for the TRIP Data Bank. Specific elements which should be considered for hard-copy versus magnetic tape data submission costs are outlined below. Data collection costs are not included as a TRIP cost consideration. TRIP imposes no additional requirements for data collection upon participants; rather, TRIP operates on a philosophy of voluntary submission of existing data. Data collection costs are, therefore, incurred by the participant whether or not data is made available to TRIP.

Hard-Copy data submission cost considerations include, but are not necessarily limited to:

- Labor required to sort out data that will be submitted;

- Labor and materials required to duplicate/reproduce property maintenance and operations data forms for TRIP submission;

- Labor required to review and clarify forms prior to submission (should be minimal if copies are made from legible masters such as the top sheet of a multi-part form);

- Cost required to transfer the copied data to the Data Bank facility (A five-pound package (approximately one ream of high-speed copier paper) can be shipped via "First Class" mail for less than $5.00, coast-to-coast.).

Magnetic tape data submission cost considerations include, but are not necessarily limited to:

- A one-time cost to set up automated procedures (i.e.: a computer program) to extract the data and produce the tape;

- Computer resources required to extract data based on:

  - Number of data records extracted;
  - Frequency of data submission;

  (NOTE: Magnetic tapes are returned and, therefore, do not represent a recurring cost.)

- Labor required for periodic data submission to:

  - Initiate automated extraction procedures;
  - Review extracted data prior to TRIP submission;

- Cost involved in transmission of data to the TRIP facility (less than $5.00 via "First Class" mail, coast-to-coast, per tape).

  (NOTE: The cost to return a magnetic tape is borne by the Data Bank.)

A more general cost consideration is that of active participation by the data source in the TRIP Liaison Board. The Liaison Board conducts a two-day work session every eight to twelve weeks, more or less. The TRIP sponsor, through APTA, reimburses transportation and lodging costs associated with these meetings. The TRIP participant, however, must cover the salary of its representative.

TRIP participation as a data source makes the participant eligible to receive the routine output reports from the Data Bank without additional cost. Special services and reports, however, are costed in advance on a case-by-case basis. The participant's contribution to the special service costs, if any, is determined by the TRIP Data Bank sponsor and Contracting Office, the Transportation Systems Center.

4.6 BENEFITS

The major benefit of participating in TRIP is that of having access to transit equipment reliability related data on a national basis. This data is analyzed, summarized, and reported at regular intervals in the form of routine, monthly output reports. These reports present an overview of maintenance requirements (expressed as rates) which can be used for a variety of purposes, including:

- Comparison of functionally similar equipment in different operating environments;
- Advance indication of potential equipment and component failure modes and increasing replacement rates which can be used as the basis for the development and justification of equipment overhaul or modification efforts;
- Indication of improved equipment performance through a product improvement program at one transit property which may be transferrable to identical equipment at other properties;
- Support for the development of more realistic and standardized equipment specifications by providing "baseline" reliability values based on "real-

world" hardware performance which can be used to specify expected reliability of new vehicles and components;

- Support for on-going industry programs and projects relating to hardware reliability, including:

  - Product Improvement Programs;
  - Systems Analysis Activities;
  - Equipment Analysis Activities;
  - Equipment Standardization;
  - Prototype Testing;

- Support for logistics improvement and planning activities, including:

  - Spare parts provisioning;
  - Facilities planning;
  - Maintenance policies development;
  - Alternate source identification.

All of the above activities can be directly supported by TRIP through its Data Bank. The uniform processing, analysis, and reporting of the data submitted by the various individual sources makes possible the industry-wide comparison of TRIP reliability information.

SECTION 5 - TRIP DATA BANK OUTPUT REPORTS

Two basic types of output reports are produced by the TRIP Data Bank: routine (i.e.: periodic) reports, and special reports. The primary purpose of the routine reports is to provide summary information on the utilization, inspection, and unscheduled maintenance of transit vehicles and equipment. Radical or quantum changes in the trend information contained in these reports are indicators that a more detailed, special report may be in order.

The purposes of this section of the Participants Guidelines are: to provide descriptions of the current routine reports; to present procedures for requesting modifications to the routine reports; to provide examples of special reports and services that can be provided by the TRIP Data Bank; and to present procedures for requesting special reports and/or services.

5.1 ROUTINE REPORTS

There are two types of routine reports: monthly reports; and annual reports. Monthly reports include summaries, by vehicle series, transit property, and the industry, of the utilization, inspection and unscheduled maintenance of transit vehicles. These reports present their information in both tabular and graphical formats. There are three types of annual reports: summaries of the monthly reports; detailed reports on certain major equipment assemblies and critical components; and reference information reports.

These reports are described in the following subsections. These descriptions are based upon the current format of each report as of the date of this writing. Since these reports are subject to change, samples of then-current reports will be provided to new participants during the familiarization meetings with the TRIP staff.

5.1.1 Monthly Reports

Monthly reports are published in multiple volumes. "Volume I" contains the industry reports which summarize the data by transit property and vehicle series. A separate volume is published for each property that is supplying data to the TRIP Data Bank. These property volumes contain the same information, detailed by car number.

All TRIP participants (i.e., members of the Liaison Board) receive a copy of the industry volume. Each property that supplies data also receives its own property volume. The TRIP sponsor (UMTA), Contracting Office, (TSC), and APTA receive a set of all volumes.

Samples of the reports contained in the monthly report volumes are included as figures and described in this section. These sample reports are presented solely to convey format. They were produced with test data and are not to be construed as accurate or representative of the data contained in the TRIP Data Bank; nor are the statistics contained therein to be construed as representative of the operation at the transit properties, or of the reliability of the equipment, identified in these sample reports. These transit properties are the data sources for the TRIP Experimental Data Bank.

As of this writing, the TRIP Data Bank is still in the prototype, or Experimental Data Bank (EDB) mode of operation. As an EDB, only six properties are submitting data. This data covers only three of eleven vehicle systems (see Appendix B) on ten vehicle series (three each from two properties, and one each from the other four properties).

The contents of the industry volume of the TRIP Monthly Report is shown in Table 5.1, and of a property volume in Table 5.2. these reports, and how they are produced, are described below.

TABLE 5.1 TRIP MONTHLY REPORT CONTENTS - INDUSTRY VOLUME

REPORT TYPE	DESCRIPTION
VDS-01	VEHICLE DATA SUMMARY
UIM-01	MONTHLY UTILIZATION, INSPECTION , AND UNSCHEDULED MAINTENANCE - Industry summary by Property and Vehicle Series
UIM-02	MONTHLY UNSCHEDULED MAINTENANCE - Vehicle Maintenance Actions by Vehicle System (Tabular)
UIM-G3	MONTHLY UNSCHEDULED MAINTENANCE - Vehicle Maintenance Actions by Vehicle System (Bar Chart)
------	MONTHLY UNSCHEDULED MAINTENANCE - Data Base Inventory

TABLE 5.2 TRIP MONTHLY REPORT CONTENTS - PROPERTY VOLUME

REPORT TYPE	DESCRIPTION
VDS-01	VEHICLE DATA SUMMARY (by count)
VDS-02	VEHICLE DATA SUMMARY (by car number)
------	PREPROCESSOR ERROR REPORT
UIM-00	MONTHLY UTILIZATION, INSPECTION AND UNSCHEDULED MAINTENANCE - Detail by Car Number

5.1.1.1 Preprocessor Error Report

A sample of this report is shown in Figure 5.1. Report VDS-00 is produced as a result of "preprocessing" the data that was extracted (copied) from the TRIP data base. One of the major functions of the Output Preprocessor Program is to compute the period mileage for each vehicle. If the computation is not possible or results in an invalid mileage (less than zero, or greater than a preset maximum) the record "key" for all records contained in the data set for the car in question are displayed in the report along with a message describing the error conditions. This report was originally intended to be used only by TRIP personnel as a "tool" for correcting and validating utilization data; hence, the property and vehicle series elements of the Generic Serial Number are not decoded into words or acronyms. The Liaison Board decided at their eighth meeting (July 22 & 23, 1980) to include this report, as is, in the property volumes.

In order to produce the monthly reports described in this document, the utilization, inspection, and unscheduled maintenance data is first extracted (copied) from the TRIP Data Bank onto an Abstract File. This data is then sorted by date to isolate the data pertaining to the month being reported. Since all of the succeeding reports are based upon the mileage accumulated during the reporting period by the vehicles, the data is run through a "preprocessor" program which attempts to compute the period mileage for each vehicle. If a non-zero, positive mileage is computed, then all of the data pertaining to the car is passed on to the succeeding report programs. If period mileage cannot be computed, or if the result is less than or equal to zero, the data pertaining to the car is output to the Preprocessor Error Report to be examined and corrected, if possible or necessary, by TRIP personnel.

The utilization records contain cumulative mileage for each vehicle along with the date for which the cumulative mileage was reported. In the ideal case where cumulative mileage for each vehicle is reported by the transit property on the last day of each month, the reporting period mileage is calculated by subtracting last month's period-ending cumulative mileage from this month's period-ending cumulative mileage.

The more normal case, however, is where the transit property provides monthly utilization data within a few days of the first of the month. In the preprocessor program, the

TRANSIT RELIABILITY INFORMATION PROGRAM
(TRIP)
PREPROCESSOR ERROR REPORT

REPORT MONTH 06/80
REPORT DATE 07/30/80

WINDOW 1 05/28/80 TO 06/03/80
WINDOW 2 06/28/80 TO 07/03/80

PROPERTY	VEHICLE SERIES	CAR NO.	RECORD TYPE	RECORD FORM	RECORD SEQ	REPORT DATE	SUB-DATE	PART NUMBER	COM-MILES OR PART NAME	ERROR CONDITION
001	101	000143	02	A	01	800616	0	A00000000000	TRANSIT VEHICLE	CAR NOT ON FLEET TABLE
			02	A	01	800721	0	A00000000000	TRANSIT VEHICLE	
001	101	000146	02	A	01	800721	0	A00000000000	TRANSIT VEHICLE	CAR NOT ON FLEET TABLE
001	101	000164	02	A	01	800521	0	A00000000000	7209	MILES THIS PERIOD = ZERO
			02	A	01	800616	0	A00000000000	7209	
			02	A	01	800721	0	A00000000000	7209	
001	101	000172	02	A	01	800521	0	A00000000000	TRANSIT VEHICLE	CAR NOT ON FLEET TABLE
			02	A	01	800721	0	A00000000000	TRANSIT VEHICLE	
001	101	000183	02	A	01	800521	0	A00000000000	TRANSIT VEHICLE	CAR NOT ON FLEET TABLE
001	101	000197	02	A	01	800616	0	A00000000000	TRANSIT VEHICLE	CAR NOT ON FLEET TABLE
001	101	000211	02	A	01	800521	0	A00000000000	293328	MILES THIS PERIOD = ZERO
			02	A	01	800616	0	A00000000000	293328	
			02	A	01	800721	0	A00000000000	293328	
001	101	000216	02	A	01	800616	0	A00000000000	TRANSIT VEHICLE	CAR NOT ON FLEET TABLE
001	101	000222	02	A	01	800521	0	A00000000000	292005	MILES THIS PERIOD = ZERO
			02	A	01	800616	0	A00000000000	292005	
			02	A	01	800721	0	A00000000000	292005	
001	101	000223	02	A	01	800521	0	A00000000000	202905	MILES THIS PERIOD = ZERO
			02	A	01	800616	0	A00000000000	202905	
			02	A	01	800721	0	A00000000000	202905	
001	101	000226	02	A	01	800521	0	A00000000000	251397	MILES THIS PERIOD = ZERO
			02	A	01	800616	0	A00000000000	251397	
			02	A	01	800721	0	A00000000000	251397	
001	102	000564	02	A	01	800521	0	A00000000000	264465	MILES THIS PERIOD = ZERO
			02	A	01	800616	0	A00000000000	264465	
			02	A	01	800721	0	A00000000000	264465	
001	102	000667	02	A	01	800521	0	A00000000000	267516	MILES THIS PERIOD = ZERO

Figure 5.1 SAMPLE — PREPROCESSOR ERROR REPORT

utilization record data set is scanned to find two utilization records: one having a date that falls within a seven-day "window" around the first of the month being reported; the other having a date that falls within a seven-day "window" around the end of the month being reported. If these two records are found, the month-beginning cumulative mileage is subtracted from the month-ending cumulative mileage, and the difference is multiplied by the ratio of the number of days in the month being reported to the number of calendar days between the record dates. The result, thus, is an estimated period mileage which has been adjusted to compensate for variations in the day of each month that the transit property submits utilization data.

If a utilization record is found in only one of the "windows", the second record is sought beyond the opposite "window". The maximum allowable spread between utilization record dates, however, is 45 days. This date limit has been imposed to minimize the interpolation error in computing the adjusted period mileage. If the date limit is not exceeded, the period mileage is computed as described above.

If no utilization records are found in either "window" then a utilization record is sought beyond both "windows". If the date spread of these two records does not exceed the 45-day limit, the period mileage is computed as described above. If the date spread exceeds the 45-day limit, a third utilization record is sought between the "windows". The period mileage computation is then done in two parts. Each part is computed by determining the difference in cumulative mileage between each record beyond the "windows" and the record between the "windows". The differences are then multiplied by the ratio of the number of days between the date of the record between the "windows" and the end (or beginning) of the month being reported to the number of days between the corresponding "pair" of utilization records. The proportional parts are then added to determine the adjusted period mileage.

The error conditions which could result from computing period mileage and cause the record set for the car to be output to the Preprocessor Error Report are defined in Table 5.3. The record set for the car is sorted by record type and report date. The error condition is displayed online with the first record in the set. The other message that appears in the error condition field of the report is placed on line with the first non-utilization record in the set (see Table 2.1 for definitions of dynamic data records). This message reads:

QUESTIONABLE UTIL. DATA FOR THIS CAR

and simply states that there is a potential problem with the utilization data for this car which should be examined and, if necessary, corrected.

5.1.1.2 Vehicle Data Summary - Report Type VDS-01

A sample of this report is shown in Figure 5.2. Report VDS-01 contains a summary of the vehicle data reporting status and represents a tabulation of the Output Preprocessor Program activities. This report is produced for each property as well as the industry and is included in the appropriate volumes of the Monthly Output Report.

The vehicle data reporting status is determined from the error code, or lack thereof, that was assigned to the car during the execution of the Preprocessor Program. Report Type VDS-01 displays an audit of the number of vehicles and associated data records versus reporting status categories. These catagories are derived from the error codes shown in Table 5.3 and are defined below:

1. UTILIZATION DATA NOT REPORTED - the number of cars (and associated data records), excluded from succeeding reports, for which inspection and/or unscheduled maintenance data was reported, but for which no utilization data was reported.

2. INSUFFICIENT UTILIZATION DATA - the number of cars (and associated data records), excluded from succeeding reports, for which period mileage could not be computed because only one utilization record is contained in the data set. (Note: At least two utilization records are required to compute period mileage.)

3. NO RECORDS WITHIN DATE LIMIT - the number of cars (and associated data records), excluded from succeeding reports, for which the date spread between available utilization records exceeded the 45-day limit.

4. CALCULATED MILES > (exceeded) MAXIMUM LIMIT - the number of cars (and associated data records), excluded from the succeeding reports, for which the calcultated period mileage exceeded the nominal ceiling limit established by the transit property. The specified ceiling limits for the five properties currently submitting data are:

TABLE 5.3 OUTPUT PREPROCESSOR ERROR CODES

ERROR CODE	ERROR CONDITION DESCRIPTION/DEFINITION
E-01	UTILIZATION DATA NOT REPORTED Inspection and/or unscheduled maintenance records, but no utilization records, are contained in the data set for this car.
E-02	INSUFFICIENT UTILIZATION DATA Period mileage cannot be computed for this car because the utilization record set does not contain enough information. (NOTE: At least two utilization records are required to compute period mileage.)
E-03	NO RECORDS WITHIN DATE LIMIT The date spread between available utilization records for this car exceeds the 45-day limit.
E-04	CALCULATED MILES > (exceeded) MAXIMUM LIMIT The period mileage computed for this car exceeds the nominal ceiling limit established by the property.
E-05	MILES THIS PERIOD < (are less than) ZERO The period mileage computation for this car resulted in a negative number.
E-06	MILES THIS PERIOD = (equal) ZERO The period mileage computed for this car equals exactly zero.
E-07	NO DATA REPORTED Although this car number is contained in the vehicle roster, no data for it exists on the data base for the month being reported.

TRANSIT RELIABILITY INFORMATION PROGRAM
(TRIP)
RAIL RAPID VEHICLE

REPORT MONTH: 06/80
REPORT DATE: 10/01/80

REPORT TYPE: VDS-01

* * * VEHICLE DATA SUMMARY * * *

: PROPERTY: BART :

VEHICLE DATA REPORTING STATUS	NUMBER OF VEHICLES INVOLVED	NUMBER OF INSPECTION RECORDS	NUMBER OF REPAIR RECORDS
UTILIZATION DATA NOT REPORTED	0	0	0
INSUFFICIENT UTILIZATION DATA	1	0	0
NO RECORDS WITHIN DATE LIMIT	0	0	0
CALCULATED MILES > MAXIMUM LIMIT	0	0	0
MILES THIS PERIOD < ZERO	0	0	0
TOTAL CARS REJECTED	1	0	0
TOTAL CARS ACCEPTED	426	202	474
(MILES THIS PERIOD = ZERO)	(8)	(0)	(0)
NO DATA REPORTED THIS PERIOD	0		
TOTAL NUMBER OF CARS ON TRIP VEHICLE ROSTER	427		

Figure 5.2 SAMPLE – REPORT TYPE: VDS-01

BART	-	15,000 miles per month
CTA	-	10,000 miles per month
NYCTA	-	8,000 miles per month
PATCO	-	15,000 miles per month
WMATA	-	10,000 miles per month

5. MILES THIS PERIOD < (are less than) ZERO - the number of cars (and associated data records), excluded from succeeding reports, for which the period mileage computation resulted in a negative number. A negative period mileage implies a data error. Typically, all such errors have been resolved prior to report publication. In some cases, however, the error cannot be resolved prior to the report publication deadline.

6. TOTAL CARS REJECTED - column totals of 1. through 5., above.

7. TOTAL CARS ACCEPTED - the number of cars (and associated data records), included in succeeding reports, for which the period mileage computation resulted in a number that is greater than or equal to zero and less than the established property ceiling limit.

8. (MILES THIS PERIOD = (equal) ZERO) - included in 7., above, the number of cars (and associated data records) for which the computed period mileage equals zero. In other words, these are the cars which did not run in revenue service during the reported month.

9. NO DATA REPORTED THIS PERIOD - the number of cars for which no utilization, inspection, or unscheduled maintenance data was reported. Although no data has been reported against these cars, the transit property has included the car numbers in the car roster provided to the TRIP Data Bank.

10. TOTAL NUMBER OF CARS ON TRIP VEHICLE ROSTER - the sum of 6., 7., and 9., above.

Report type VDS-01 is contained in all volumes of the Monthly Output Report. The sample report shown in Figure 5.2 contains the statistics that would appear in the industry volume, as evidenced by the PROPERTY banner containing the word: "ALL".

5.1.1.3 Vehicle Data Summary - Report Type VDS-02

A sample of this report is shown in Figure 5.3. Report VDS-02 contains a listing, by error condition, of all car numbers that were rejected from further processing as well as those car numbers, included in futher processing, which accumulated no (zero) mileage during the reported period. This report is produced for and contained in the industry volumes only. The abbreviated column headings in Report Type VDS-02 are derived from the reporting status categories of Report Type VDS-01.

5.1.1.4 Monthly Utilization, Inspection, and Unscheduled Maintenance - Detail by Car Number - Report Type UIM-00

A sample of this report is shown in Figure 5.4. Report UIM-00 contains a listing, by car number (GSN, actually), of: the period mileage; number of inspection records versus number of unique inspection dates; 3-, 6-, and 12-month inspection periods (based on mileage); number of maintenance actions (based upon unique maintenance dates); 3-, 6-, and 12-month repair rates (based on mileage); number of maintenance records versus the number for which no defect was found. This report was originally intended to be used only by TRIP personnel for data validation and error correction; hence, the property and vehicle series elements of the Generic Serial Number (GSN) are not decoded into words or acronyms. The Liaison Board decided at their eighth meeting (July 22 & 23, 1980) to include this report, as is, in the property volumes.

The purpose of Report Type UIM-00 is to display vehicle inspection periods and unscheduled maintenance rates on a car-by-car basis. These statistics are computed by a Rates & Periods Program. Although Report Type UIM-00 displays only the total vehicle maintenance rates, the Rates & Periods Program also computes the maintenance rates for each vehicle system. The vehicle and system maintenance rates are summarized by vehicle series and displayed in Report Types UIM-01 and UIM-02 (see below). The methods used to compute these statistics are included below along with the definitions of column headings appearing in Report Type UIM-00.

TRANSIT RELIABILITY INFORMATION PROGRAM
(TRIP)
RAIL RAPID VEHICLE

REPORT MONTH: 06/80
REPORT DATE: 10/01/80

REPORT TYPE: VDS-02

* * * VEHICLE DATA SUMMARY * * *

: PROPERTY: BART :

* * CARS REJECTED FROM FURTHER PROCESSING * *

NO UTIL REPORTED	INSUFFICIENT UTIL DATA	EXCEEDED DATE LIMIT	EXCEEDED MILES LIMIT	MILES LESS THAN ZERO	NO DATA REPORTED
	000803				

PERIOD MILEAGE EQUALS ZERO

000164	000211
000222	000223
000226	000564
000669	000675

Figure 5.3 SAMPLE — REPORT TYPE: VDS-02

TRANSIT RELIABILITY INFORMATION PROGRAM
(TRIP)
RAIL RAPID VEHICLE

REPORT MONTH: 06/80
REPORT DATE: 10/01/80

MONTHLY UTILIZATION, INSPECTION,
AND UNSCHEDULED MAINTENANCE
DETAIL BY CAR NUMBER

REPORT TYPE: UIM-00

: PROPERTY: BART :

<---- G S N ----> PROP ID	VEH SER	CAR NUMBER	PERIOD MILES	NO. OF INSP RECORDS	TOTAL INSP	<--- AVERAGE MILES/INSP ---> THREE MONTH	SIX MONTH	TWELVE MONTH	VEHICLE MAINT ACTIONS	<- MAINT ACT / 10K MILES --> THREE MONTH	SIX MONTH	TWELVE MONTH	TOTAL MAINT RECORDS	NO DEFECT FOUND
001	101	101	00001344	0	0	05822	10121	09819	0	03.4	04.0	02.5	0	0
001	101	102	00000128	0	0	00702	06536	07563	0	42.7	05.4	03.3	0	0
001	101	104	00005146	0	0	12546	10935	10945	0	--	01.4	02.7	0	0
001	101	106	00006651	1	1	08390	10025	07717	2	02.4	03.7	02.8	3	0
001	101	107	00007179	1	1	09314	09354	08620	2	01.1	00.8	01.2	3	0
001	101	108	00006533	1	1	09030	08377	10017	0	01.7	02.7	02.7	0	0
001	101	110	00004902	0	0	11022	11238	10116	5	08.2	04.9	07.9	5	2
001	101	111	00005774	1	1	08908	08783	09017	2	02.2	01.4	02.2	6	0
001	101	112	00005283	1	1	10701	06830	08709	0	04.7	05.9	04.6	0	0
001	101	113	00006082	1	1	06233	08073	07966	0	04.0	05.0	06.0	0	0
001	101	114	00004463	0	0	11799	06753	09124	3	05.1	03.9	06.2	3	1
001	101	115	00004237	1	1	07434	07907	07410	1	02.7	02.2	01.9	3	0
001	101	116	00004911	0	0	14027	11210	10593	1	06.4	03.3	02.1	1	0
001	101	119	00007539	1	1	08181	07844	08767	3	04.9	03.4	03.4	3	0
001	101	121	00006894	1	1	09905	09561	10306	1	03.0	03.8	02.9	1	0
001	101	122	00007038	0	0	09786	11993	08827	0	00.5	02.2	02.6	0	0
001	101	123	00006327	1	1	07920	10420	09973	0	03.2	02.2	03.0	0	0
001	101	124	00005460	0	0	14897	09829	07415	1	02.0	01.7	02.9	1	1
001	101	125	00006447	0	0	14238	09951	09842	1	01.4	03.3	04.1	1	0
001	101	126	00006927	0	0	09786	11600	09206	0	01.5	01.1	01.4	0	0
001	101	127	00005247	0	0	15972	10046	08360	0	00.6	01.0	00.8	0	0
001	101	128	00005280	0	0	12595	09526	08289	2	04.0	02.8	03.9	4	0
001	101	129	00007951	1	1	10004	11940	09295	1	01.0	01.7	02.0	1	0
001	101	130	00004975	1	1	08237	08357	09740	3	01.8	01.2	01.9	5	0
001	101	131	00006391	1	1	06334	08047	08843	1	01.6	01.2	01.1	1	1
001	101	132	00005030	0	0	14700	08905	11822	1	01.4	01.4	01.3	1	1
001	101	133	00002242	0	0	08339	11113	13094	1	13.2	08.1	09.9	1	0
001	101	134	00004805	0	0	11525	12457	11591	1	06.1	04.0	04.5	1	1
001	101	135	00005779	1	1	07694	09247	09983	3	07.1	05.4	04.0	3	2
001	101	136	00007301	1	1	14446	08962	10037	1	00.7	03.0	02.8	1	0
001	101	138	00004844	0	0	15333	09800	09213	2	02.6	02.6	02.7	5	0
001	101	139	00001328	0	0	08348	11837	09463	0	03.6	02.5	02.4	0	0
001	101	140	00004587	1	1	07113	07658	09662	1	02.8	03.5	02.7	2	0
001	101	141	00006665	1	1	07960	09374	08425	1	01.9	01.6	01.5	1	0
001	101	142	00002240	0	0	12451	10362	14614	0	01.6	03.4	03.8	0	0
001	101	144	00004231	0	0	12085	09348	09691	1	01.7	02.5	02.7	1	1
001	101	145	00004658	1	1	09287	09524	09623	0	01.1	00.8	01.6	0	0
001	101	148	00006007	1	1	07993	10055	09498	2	03.8	02.7	03.2	2	0
001	101	149	00005224	1	1	07680	08484	10306	1	01.3	00.9	01.0	1	0
001	101	150	00003515	1	1	06845	07608	12480	1	01.5	00.9	01.1	1	0

Figure 5.4 SAMPLE — REPORT TYPE: UIM-00

TABLE 5.4 PROPERTY AND VEHICLE SERIES DEFINITIONS

PROP ID	VEH SER	Property Acronym	Vehicle Series
001	--	BART	(All Cars)
001	102	"	A-Cars
001	102	"	B-CARS
001	103	"	A/B Cars
002	--	CTA	(All Cars)
002	101	"	2400 Series
003	--	GCRTA	(All Cars)
003	101	"	Airporter
004	--	NYCTA	(All Cars)
004	101	"	R-44 Cars
005	--	PATCO	(All Cars)
005	101	"	Singles
005	102	"	Old Pairs
005	103	"	New Pairs
006	--	WMATA	(All Cars)
006	101	"	ROHR Pairs

Generic Serial Number (GSN) - The three elements of the GSN are displayed in the first three columns of Report Type UIM-00.

PROPerty ID - a number used to represent the transit property acronym (see Table 5.4).

VEHicle SERies - when used in combination with PROP ID, defines a specific grouping or class of vehicles. In TRIP, a vehicle series is a grouping of vehicles based upon the following definitions:

- Single or multiple-unit (e.g.: married pairs) vehicles purchased under a specific contract (e.g.: NYCTA's "R-44" cars);
- Single vehicles whose configuration differs from another "type" of vehicle purchased under the same contract (e.g.: BART's "A" versus "B" cars);
- Both of the above (e.g.: PATCO's single cars versus their married pairs).

Combinations of property ID and vehicle series are defined in Table 5.4.

CAR NUMBER - car body number; the number by which a specific vehicle is identified.

PERIOD MILES - two types of information are presented in this column: period mileage; or an error code (refer to the description of the Preprocessor Output Report, above).

NO. OF INSPection RECORDS - the number of inspection records contained in the monthly data set for the car as determined by a physical count.

TOTAL INSPections - an estimate of the number of inspections performed on each car during the reported month, as determined by a physical count of the number of unique inspection dates contained in the inspection records for each car.

AVERAGE MILES/INSPection:

- THREE MONTH - The sum of PERIOD MILES for this month plus previous two, divided by the sum of TOTAL INSP for this month plus

previous two (NOTE: Four dashes in this column indicate that the three-month sum of TOTAL INSP = 0, and the quotient is indeterminate; four stars or asterisks in this column indicate that PERIOD MILES could not be determined or is not available for one or more of the three months.);

- SIX MONTH - The sum of PERIOD MILES for this month plus previous five, divided by the sum of TOTAL INSP for this month plus previous five (NOTE: four dashes in this column indicate that the six-month sum of TOTAL INSP = 0, and the quotient is indeterminate; four stars or asterisks in this column indicate that PERIOD MILES could not be determined or is not available for one or more of the six months.);

- TWELVE MONTH - The sum of PERIOD MILES for this month plus previous eleven, divided by the sum of TOTAL INSP for this month plus previous eleven (NOTE: four dashes in this column indicate that the twelve-month sum of TOTAL INSP = 0, and the quotient is indeterminate; four stars of asterisks in this column indicate that PERIOD MILES could not be determined or is not available for one or more of the twelve months.).

VEHICLE MAINTenance ACTIONS - an estimate of the number of times that a vehicle was brought into the shop for unscheduled maintenance during the reported month, as determined by a physical count of the number of unique maintenance dates contained in the repair (unscheduled maintenance) records for each car.

MAINTenance ACTions/10K (ten thousand) MILES:

- THREE MONTH - the sum of VEHICLE MAINT ACTIONS for this month plus previous two, multiplied by 10,000 and divided by the sum of PERIOD MILES for this month plus previous two (NOTE: Four dashes in this column indicate that the three-month sum of PERIOD MILES = 0, and the quotient is indeterminate; four stars or asterisks in this column indicate that PERIOD MILES could not be determined or is not available for one or

more of the three months; two dashes means that the computed maintenance rate equals zero; two stars or asterisks means that the computed maintenance rate is greater than zero, but less than 0.1);

- SIX MONTH - the sum of VEHICLE MAINT ACTIONS for this month plus previous five, multiplied by 10,000 and divided by the sum of PERIOD MILES for this month plus previous five (NOTE: Four dashes in this column indicate that the six-month sum of PERIOD MILES = 0 , and the quotient is indeterminate; four stars or asterisks in this column indicate that PERIOD MILES could not be determined or is not available for one or more of the six months; two dashes means that the computed maintenance rate equals zero; two stars or asterisks means that the computed maintenance rate is greater than zero, but less than 0.1);

- TWELVE MONTH - the sum of VEHICLE MAINT ACTIONS for this month plus previous eleven, multiplied by 10,000 and divided by the sum of PERIOD MILES for this month plus previous eleven (NOTE: Four dashes in this column indicate that the twelve-month sum of PERIOD MILES = 0, and the quotient is indeterminate; four stars or asterisks in this column indicate that PERIOD MILES could not be determined or is not available for one or more of the twelve months; two dashes mean that the computed maintenance rate equals zero; two stars or asterisks means that the computed maintenance rate is greater than zero, but less that 0.1).

TOTAL MAINTenance RECORDS - the number of unscheduled maintenance records contained in the monthly data set for each car as determined by a physical count.

NO DEFECT FOUND - the number of MAINT RECORDS for which the Defect and/or Repair Code contained in the record indicates that a defect could not be found or confirmed and, therefore, no repair was made.

5.1.1.5 Monthly Utilization, Inspection, and Unscheduled Maintenance - Industry Summary By Vehicle Series - Report Type UIM-01

A sample of this report is shown in Figure 5.5. The purpose of this report is to display, by vehicle series and property, a summary of the vehicle inspection periods and unscheduled maintenance rates. Report Type UIM-01 is contained in the industry volume only of the Monthly Output report.

Report Type UIM-01 is derived from the detailed (by car number) statistics contained in Report Type UIM-00 (see above). In this report, however, the statistics are aggregated to the vehicle series and transit property.

The PROPERTY AND VEHICLE SERIES elements of the Generic Serial Number are "translated" into words in accordance with Table 5.4. The NO. OF ACTIVES CARS is the count, by vehicle series, then property, of those cars from Report Type UIM-00 whose PERIOD MILES was zero (error code E-06) or greater. TOTAL MILES is the sum of PERIOD MILES from Report Type UIM-00. AVERAGE MILES PER CAR is TOTAL MILES divided by NO. OF ACTIVE CARS.

CARS INSPected is the sum of TOTAL INSPections from UIM-00. VEHICLE MAINTenance ACTIONS, TOTAL MAINTenance RECORDS, and NO DEFECT FOUND in Report Type UIM-01 each contain the sum of the corresponding columns from UIM-00.

Inspection periods (AVERAGE MILES/INSP) and maintenance rates (MAINT ACT/10K MILES) are computed in the same manner as for Report Type UIM-00 except that the ratio elements are now: TOTAL MILES, instead of PERIOD MILES: CARS INSPected, instead of TOTAL INSPections (by car); and (total) VEHICLE MAINTenance ACTIONS, instead of (individual) VEHICLE MAINTenance ACTIONS. Report Type UIM-01 displays, therefore, "weighted averages" of inspection intervals and maintenance rates for each vehicle series, for each property, and for the industry.

TRANSIT RELIABILITY INFORMATION PROGRAM
(TRIP)
RAIL RAPID VEHICLE

REPORT MONTH: 06/80
REPORT DATE: 10/01/80

MONTHLY UTILIZATION, INSPECTION,
AND UNSCHEDULED MAINTENANCE
INDUSTRY SUMMARY BY VEHICLE SERIES

REPORT TYPE: UIM-01

: INDUSTRY SUMMARY :

PROPERTY AND VEHICLE SERIES	NO. OF ACTIVE CARS	TOTAL MILES	AVERAGE MILES PER CAR	CARS INSP	<--- AVERAGE MILES/INSP ---> THREE MONTH	SIX MONTH	TWELVE MONTH	VEHICLE MAINT ACTIONS	<--MAINT ACT / 10K MILES --> THREE MONTH	SIX MONTH	TWELVE MONTH	TOTAL MAINT RECORDS	NO DEFECT FOUND
BART A-CARS	156	823,977	5,281	83	09434	09395	****	155	02.3	02.5	****	206	40
BART B-CARS	268	1,308,070	4,880	117	09904	09622	****	213	01.7	01.7	****	267	37
BART A/B-CARS	2	10,721	5,360	2	07245	07855	****	1	00.7	00.8	****	1	0
ALL CARS	426	2,142,768	5,029	202	09707	09529	****	369	01.9	02.0	****	474	77
CTA 2400SERIS	194	967,160	4,985	115	08350	08081	****	405	04.7	06.0	****	444	220
ALL CARS	194	967,160	4,985	115	08350	08081	****	405	04.7	06.0	****	444	220
GRCTA AIRPORT	0	0	0	0	****	****	****	0	****	****	****	0	0
ALL CARS	0	0	0	0	****	****	****	0	****	****	****	0	0
NYCTA R-44	288	729,372	2,532	186	06619	07281	****	339	04.2	04.3	****	2247	0
ALL CARS	288	729,372	2,532	186	06619	07281	****	339	04.2	04.3	****	2247	0
PATCO SINGLES	25	108,682	4,347	7	12105	10212	****	50	05.9	06.2	****	94	20
PATCO O PAIRS	56	115,188	2,303	16	11969	08722	****	67	05.2	05.4	****	88	21
PATCO N PAIRS	18	77,342	4,296	4	17774	22455	****	41	04.1	03.3	****	46	20
ALL CARS	93	301,212	3,238	27	12951	10124	****	158	05.2	05.4	****	228	61
WMATA ROHR	296	1,630,488	5,508	150	09191	09398	****	786	04.8	04.7	****	1201	121
ALL CARS	296	1,630,488	5,508	150	09191	09398	****	786	04.8	04.7	****	1201	121
INDUSTRY ALL	1277	5,771,000	4,449	680	08934	08918	****	2057	03.6	03.9	****	4594	479

Figure 5.5 SAMPLE — REPORT TYPE: UIM-01

5.1.1.6 Monthly Unscheduled Maintenance - Vehicle Maintenance Actions by Vehicle System - Report Type UIM-02.

A sample of this report is shown in Figure 5.6. The purpose of this report is to display the 3-, 6-, and 12-month repair rates, by vehicle series, property, and industry, for the three EDB vehicle systems (doors, propulsion, and friction brakes) as well as the aggregate of the three systems (total vehicle). Report UIM-02 appears in the industry volume only of the Monthly Output Report.

Repair rates are expressed in terms of unscheduled maintenance actions per 10,000 miles of revenue service operation. For the TOTAL VEHICLE, the repair rates are the MAINT ACT/10K MILES from Report UIM-01 (see above). In other words, for the 3-month interval, the repair rate is the 3-month sum of unique repair dates from all repair (unscheduled maintenance) records for each car, multiplied by 10,000 and divided by the 3-month sum of period mileage. The repair rates are similarly computed for the 6- and 12-month intervals. Repair rates for the three EDB vehicle systems are also calculated on the basis of unique repair dates. The number of unique repair dates is determined by sorting the repair records for each car by the vehicle system identified in the Generic Part Number and then counting unique repair dates within each system subset of the repair records.

Since it is possible to generate a repair record against more than one system for a single vehicle trip to the shop, the sum of unique repair dates for the three vehicle systems may be greater than the number of unique repair dates for the total vehicle. The TOTAL VEHICLE repair rates in Report UIM-02 are, therefore, aggregate rates rather than the sum of VEHICLE SYSTEM repair rates.

The calculated repair rate is displayed in Report UIM-02 if its value is greater than or equal to 0.1. Two stars or asterisks indicate that the calculated repair rate is greater than zero and less that 0.1. Two dashes indicate that the calculated repair rate equals (exactly) zero. Four stars or asterisks indicate that period mileage could not be compute or is not available for one or more months within the interval. Four dashes indicate that the sum or mileage over the interval equals zero, and the repair rate calculation is therefore indeterminate.

TRANSIT RELIABILITY INFORMATION PROGRAM
(TRIP)
RAIL RAPID VEHICLE

REPORT MONTH: 06/80
REPORT DATE: 10/01/80

MONTHLY UNSCHEDULED MAINTENANCE
VEHICLE MAINTENANCE ACTIONS
BY VEHICLE SYSTEM

REPORT TYPE: UIM-02

UNSCHEDULED MAINTENANCE ACTIONS PER 10,000 MILES OF REVENUE SERVICE OPERATION

TRANSIT PROPERTY	VEHICLE SERIES	3-MONTH INTERVAL TOTAL VEHICLE	3-MONTH INTERVAL VEHICLE SYSTEM DOOR	3-MONTH INTERVAL VEHICLE SYSTEM PROP	3-MONTH INTERVAL VEHICLE SYSTEM FR BRK	6-MONTH INTERVAL TOTAL VEHICLE	6-MONTH INTERVAL VEHICLE SYSTEM DOOR	6-MONTH INTERVAL VEHICLE SYSTEM PROP	6-MONTH INTERVAL VEHICLE SYSTEM FR BRK	12-MONTH INTERVAL TOTAL VEHICLE	12-MONTH INTERVAL VEHICLE SYSTEM DOOR	12-MONTH INTERVAL VEHICLE SYSTEM PROP	12-MONTH INTERVAL VEHICLE SYSTEM FR BRK
BART	A-CARS	02.5	00.4	01.4	00.5	02.5	00.5	01.6	00.5	****	****	****	****
BART	B-CARS	01.7	00.3	01.1	00.4	01.7	00.3	01.2	00.4	****	****	****	****
BART	A/B-CARS	00.7	--	00.3	00.3	00.8	--	00.5	00.3	****	****	****	****
BART	ALL CARS	01.9	00.3	01.2	00.4	02.0	00.4	01.3	00.4	****	****	****	****
CTA	2400SERIES	04.7	01.0	02.9	00.9	06.0	01.8	03.3	01.2	****	****	****	****
CTA	ALL CARS	04.7	01.0	02.9	00.9	06.0	01.8	03.3	01.2	****	****	****	****
GCRTA	AIRPORTER	****	****	****	****	****	****	****	****	****	****	****	****
GCRTA	ALL CARS	****	****	****	****	****	****	****	****	****	****	****	****
NYCTA	R-44 CARS	04.2	02.3	02.0	01.5	04.3	02.1	01.8	01.7	****	****	****	****
NYCTA	ALL CARS	04.2	02.3	02.0	01.5	04.3	02.1	01.8	01.7	****	****	****	****
PATCO	SINGLES	05.9	01.7	03.7	01.1	06.2	01.6	03.9	01.4	****	****	****	****
PATCO	OLD PAIRS	05.2	01.5	03.1	00.9	05.4	01.3	03.5	00.8	****	****	****	****
PATCO	NEW PAIRS	04.1	01.0	02.5	00.8	03.3	00.8	02.0	00.7	****	****	****	****
PATCO	ALL CARS	05.2	01.4	03.2	01.0	05.4	01.3	03.5	01.0	****	****	****	****
WMATA	ROHR PAIRS	04.8	00.4	03.0	01.6	04.7	00.3	02.9	01.7	****	****	****	****
WMATA	ALL CARS	04.8	00.4	03.0	01.6	04.7	00.3	02.9	01.7	****	****	****	****
INDUSTRY	ALL CARS	03.6	00.8	02.2	01.0	03.9	00.9	02.2	01.1	****	****	****	****

Figure 5.6 SAMPLE – REPORT TYPE: UIM-02

Figure 5.7 SAMPLE — REPORT TYPE: UIM-G3

GENERIC P/N	IND	NOMENCLATURE	BART	CTA	NYCTA	PATCO	WMATA	TOTAL
AECO.....	3	VENTILATION COOLING	X--11	X---6				17
AEDO.....	3	TRACTION MOTOR ASSY						
AEDA.....	4	TRACTION MOTOR	X--44	X--12	X--18	X--31	X-112	217
AEDB.....	4	SUPPORTS MOUNTS	X----				X----	
AEDC.....	4	COUPLINGS	X----		X---3	X----	X---2	5
AEEO.....	3	EQUIPMENT BOXES	X---2	X----	X--48	X---2	X--77	129
	(4)	SYSTEM TOTAL	299	249	797	143	794	2282
AF00.....	2	FRICTION BRAKE SYSTEM	X--13	X---1	X--11		X----	25
AFAO.....	3	MASTER BRAKE CNTRL, T/L						
AFAA.....	4	EMERGENCY BRAKE CONTROL	X----	X--31			X--13	44
AFAB.....	4	PARKING BRAKE CONTROLS	X----					
AFAC.....	4	T/L, BRAKE CONTROL	X----					
AFBO.....	3	SERVICE BRAKING CNTLR						
AFBA.....	4	LOGIC & CONTROL LO V	X--19	X---4	X--50	X--16	X--42	131
AFBB.....	4	ANNUNCIATION EQUIPMENT	X---1					1
AFBC.....	4	CONTROL, HYD/PNEU	X--40		X-334	X---8	X-113	495
AFBD.....	4	UNDERCAR WIRING BRAKE		X---3		X----		3
AFBE.....	4	PIPING, HOSES & FITTIN	X---1	X----	X-272	X---3	X---7	283
AFCO.....	3	PUMP/COMPRESSOR ASSY		X----				
AFCA.....	4	HYDRAULIC PUMP ASSY	X----				X--11	11
AFCB.....	4	COMPRESSOR ASSY			X-226	X---8		234
AFDO.....	3	BRAKE PARTS, ROTATING						
AFDA.....	4	FRICTION ELEMENT	X---1	X----			X--40	41
AFDB.....	4	MOUNT	X----					
AFEO.....	3	BRAKE PARTS, STATIONARY						
AFEA.....	4	SUPPORTING STRUCTURES	X----		X----	X----	X--40	40
AFEB.....	4	ACTUATOR ASSY	X---7	X--13	X----	X---1	X--45	66
AFEC.....	4	FRICTION ELEMENT	X----	X--29				29
AFFO.....	3	PARKING/HAND BRK CNTLR						
AFFA.....	4	PARKING BRAKE APPLICAT	X--10	X----				10
AFFB.....	4	HAND BRAKE APPLICATOR				X----	X--39	39
AFHO.....	3	TRACK BRAKE ASSY		X---1				1
AFHA.....	4	SUPPORTING STRUCTURE						
AFHB.....	4	BRAKE ELEMENT						
AFHC.....	4	CONTROLS						
AFHD.....	4	WIRING HARNESS						
AFJO.....	3	TRACK SANDER ASSY		X----				
AFJA.....	4	BULK STORAGE CONTAINER						
AFJB.....	4	DUCTS & CHUTES						
AFJC.....	4	VALVES & GATES						
AFJD.....	4	CONTROLS						
AFJE.....	4	WIRING HARNESS						
	(4)	SYSTEM TOTAL	92	82	893	35	350	1453
		TOTAL 04D01 RECORDS	474	444	2247	213	1201	4609

Figure 5.8 SAMPLE — DATA BASE AUDIT

5.1.1.7 Monthly Unscheduled Maintenance - Vehicle Maintenance Actions by Vehicle System - Report Type UIM-G3

A sample of this report is shown in Figure 5.7. The purpose of this report is to display graphically, in bar chart form, the repair rates contained in Report Type UIM-02 (see above). Report Type UIM-G3 displays repair rates by property and industry, for the three EDB vehicle systems (doors, propulsion, and friction brakes). This report appears only in the industry volume of the Monthly Output Report.

The repair rates in Report Type UIM-G3 are plotted in increments of 0.5, with the decimal ("D") round-off being defined as follows:

$.3 \leq D < .8$ is plotted as .5

$.8 \leq D < .3$ is plotted as .0

NOTE: Other methods of presenting TRIP reliability information graphically are being explored by the Liaison Board. As of this writing, several alternative approaches to presenting the data in trend plots are being reviewed. Samples of these reports will be included as future revisions to these Guidelines.

5.1.1.8 Monthly Unscheduled Maintenance - Data Base Inventory

The Data Base Inventory report appears only in the industry volume of the Monthly Output Report. A sample of this report is shown in Figure 5.8. The purpose of this report is to display an inventory, by property, of the number of unscheduled maintenance records in the monthly data set versus Generic Part Number (GPN). Eight levels of indenture are contained in the GPN as defined below (see also Figure 2.5 in Section 2.2):

FUNCTIONAL HIERARCHY (see Appendix B):

1. Equipment Type (here, "Transit Vehicle")

2. Functional System

3. Functional Subsystem

4. Major Assembly

EQUIPMENT BREAKDOWN:

5. Assembly

6. Subassembly

7. Sub-subassembly

8. Component

In the other reports contained in the Monthly Output Report, repair rates are computed at either the first (vehicle) or second (system) level of indenture. Record counts in those reports are based upon the contents of the first character of the GPN (i.e.: all records), or the first two characters (system). The inventory displayed in this multi-page report is produced at the third, fourth and fifth levels of indenture by aggregating the results of an inventory by the complete GPN to the first three, four, and six GPN characters, respectively.

The first column of the Data Base Inventory displays the leading characters of the Generic Part Number which correspond to the level of indenture at which the report is produced. The INDenture column displays the actual level of indenture represented by the partial GPN.

In the columns labeled by a property acronym, the symbol "X" signifies that the property's Generic Parts List (see Section 2.2) contains at least one property part number cross-referenced to a Generic Part Number having the same leading characters. By comparing the property columns in this report, the correlation between Generic Parts Lists can be determined by the appearance of the symbol "X" on a given line.

The number displayed in the property column represents the number of unscheduled maintenance records contained in the monthly record set whose GPN begins with the same characters displayed in the first column. Line totals for each partial GPN and column totals for each property are also displayed.

5.1.2 Annual Reports

The TRIP Data Bank is currently operating as a prototype Experimetal Data Bank. The basic concepts of the TRIP Data Bank have been defined and developed, and the EDB is being used to implement, test, and refine those concepts.

The TRIP EDB completed its first year of operation in August, 1980. The year began with two properties submitting dynamic data and ended with five properties on line. Although all of the record types defined in Table 2.1 and described in Appendix A have been implemented in the EDB, only dynamic data (Record Types A, C, and D) was entered during the first year. This data was used to develop the monthly reports described in the preceeding subsection.

Although annual reports are "a thing of the future" for TRIP, they can be described in general terms. The Liaison Board will provide guidance for the development of annual reports as it is doing for monthly reports. The results of this joint development effort will be incorporated into future revisions to these Guidelines.

Three types of annual reports have been proposed: summaries of the Monthly Output Reports; detailed reports on certain major equipment assemblies and critical components; and reference information reports.

5.1.2.1 Annual Unscheduled Maintenance Summary Reports

Monthly Output Reports focus on vehicle and vehicle system unscheduled maintenance and aggregate this information to encompass an entire vehicle series or property. The annual summary reports will present this information from alternate perspectives such as:

- Unscheduled maintenance versus component classifications (see Appendix C);
- Unscheduled maintenance versus Generic Maintenance Action Codes:
- Data base inventory of unscheduled maintenance versus car number and vehicle series; etc.

5.1.2.2 Annual Equipment Reports

Annual reports will be produced for certain major equipment assemblies and critical components. These reports will utilize both dynamic and reference data to produce detailed analyses such as:

- Maintenance requirements versus operating environment;
- Maintenance requirements of functionally equivalent, yet physically different, equipment; etc.

5.1.2.3 Reference Information Reports

Reference information reports are produced from the reference data stored in the TRIP Data Bank. This information is used by TRIP participants to interpret the reliability, performance, and maintenance information produced by the Data Bank. Reference information reports are produced for each property after participation as a data source begins and reference data from the property is collected, validated, and input to TRIP.

Reference information reports for the new data source are distributed to all TRIP participants after the report has been validated by the new participant. Changes and supplemental information are thereafter published and distributed as an annual report encompassing all participants.

5.2 ROUTINE REPORT MODIFICATION REQUESTS

In the Experimental Data Bank mode of operation, the format and content of all routine output reports produced by TRIP are being defined and refined through the active participation of the TRIP Liaison Board. After TRIP makes the transition from the EDB to a full-scale Data Bank, occasional changes and/or additions to the output reports may continue to be required. The purpose of this section of the Guidelines is to present proposed procedures for requesting and implementing changes to the routine output reports of the (full-scale) TRIP Data Bank.

Because of the industry-wide orientation of TRIP, changes and/or additions to the routine output reports should meet the needs of the overall program, rather than the needs of a specific user. All changes and/or additions must, therefore, be approved by the Contracting Officers' Technical Representative (COTR) and the TRIP Liaison Board.

5.2.1 Submittal Procedures

Modification requests must be submitted in written form to the Program Manager of the TRIP operating staff. (Approximately six weeks will be required to process and review a modification request before it can be presented to the Liaison Board, so the urgency of the request versus submittal timing should be carefully considered.) The submittal should contain, as a minimum:

- Narrative description of the proposed change(s)/ addition(s);
- Part numbers (property and generic, if known) and descriptions of equipment effected;
- Marked-up samples of output reports to be changed, or hand-drawn samples of new outputs;
- Narrative description of any analyses required, including:
  - required data elements (from Appendix A);
  - algorithms;
  - equations; etc.

All modification requests will be "logged in" by the TRIP staff, and written confirmation of receipt will be forwarded to the requestor.

5.2.2 Review Process

Copies of the modification request will be made by the TRIP staff and forwarded to the COTR and a Change Review Board consisting of up to five members of the Liaison Board

(or 20 percent of Board membership, whichever is greater). The responsibilities of each group in the review process are outlined below:

- TRIP staff:
  - determine if the Data Bank contains the data required to produce the new or modified report;
  - estimate the "set-up" costs and implementation schedule;
  - estimate the effect, if any, on routine report production (cost; schedule; etc.);
  - coordinate the activities of all groups involved in the review;
- Change Review Board:
  - review the algorithms, equations, etc., for consistency with the stated (narrative) objective(s) of the change request;
  - assess the industry-wide applicability of the proposed change or new report;
- Contracting Officer's Technical Representative:
  - review recommendations from TRIP staff and change Review Board;
  - determine the applicability of the proposed change or new report to the overall program goals and objectives;
  - decide whether the change request should be brought to the entire Liaison Board.

The COTR has veto power over all proposed changes or additions to output reports. A veto may be necessary for either financial or technical reasons. If such reasons do not exist, the Change Request will be presented to the Liaison Board at thier next scheduled meeting.

Some Change Requests may require changes in the content of the data being supplied by one or more properties. Each member of the Liaison Board is, therefore, given opportunity to review and comment upon the proposed change. Assuming a COTR veto is not necessary, the Liaison Board will decide, based upon a majority concensus of members present, whether or not the proposed change is in order and should be implemented.

5.2.3 Change Notification and Implementation

All Liaison Board members and other users of TRIP will be sent written notification of approved changes or additions to the routine output reports. The notificatin will include a copy of the Change Request and implementation schedule. The notification will also include an estimate of when the change will first appear in the routine output report.

The implementation schedule and "first appearance" estimate will be based upon the availability of data necessary to support the change/addition. The TRIP staff will work with sources not currently supplying the required data element(s) to modify, where possible, their data submission.

5.3 SPECIAL REPORTS/SERVICES

In addition to routine reports and reference information outputs, the TRIP Data Bank can also provide a limited number of special reports and services for participants and users. Special reports and services are provided in response to requests for information which is not normally provided through the routine, periodic reports. The characteristics of a special report or service are, therefore:

- Addresses the needs of a limited rather than general audience;
- Provided for a limited duration rather than continuously.

Special reports and services must be approved in advance by the TRIP Contracting Officer's Technical Representative (COTR). The types of special reports and services that TRIP can provide are described in the following subsections. Procedures for requesting special reports and services are described in Section 5.4.

Based upon the complexity of the special report(s) or duration of special service(s), the requesting agency may be required to reimburse all, or a portion, of the costs associated with providing the special report or service. This determination is made by the TRIP COTR.

5.3.1 One-Time Reports

Inevitably, questions will arise concerning the use, operation, and/or maintenance requirements of specific eqquipment being monitored by the TRIP data bank. These questions will require detailed answers which are not provided through routine Data Bank output reports due to their general, summary orientation. Generally speaking, such questions are very specific and can be answered by a single (i.e. "one-time") special report.

Special reports can draw upon the full range of dynamic and reference data being collected and stored by the TRIP Data Bank. The range of possibilities for a special report includes, but is not necessarily limited to:

- Retrieval of data being stored in the TRIP Data Bank, but not routinely reported;
- Simultaneous retrieval of both dynamnic and reference data on an individual component or assembly for presentation in a single report;
- Comparison of functionally similar, yet physically different components;
- Comparison of the effects of operating environment on functionally and pysically similar equipment;
- Presentation of long-term industry averages for maintenance requirements on specific hardware for use in preparing new equipment specifications;
- Comparison of data collection and reporting methods of TRIP data sources for consideration by either new and emerging transit authorities or existing transit authorities contemplating changes to current methods.

5.3.2 Special Services

TRIP participants may occasionally require support for special projects and programs of extended (but finite) duration. Such requirements may arise from:

- Product Improvement Programs;
- Warranty Assurance Programs;
- Prototype Evaluation Programs; etc.

Special services, therefore, may include the collection, storage, and analysis of unusually detailed data as well as the production of one or more special reports. These services may be required for a few months, or a few years, depending upon the nature of the program being supported. TRIP, because of the scope of its Data Bank and flexibility of inputting and reporting data, may be an efficient and cost-effective alternative for supplying these services.

5.4 SPECIAL SERVICE REQUESTS

Special requests of the TRIP Data Bank will be evaluated and responded to on an individual basis. Three major areas are addressed in this evaluation:

- Is the request within the scope and capability of the TRIP Data Bank?
- Does the request have industry-wide application, or is it meaningful only to the requestor?
- What are the costs associated with the requested service?

Funding for TRIP does include resources for a limited number of special requests. Because of the industry-wide orientation of TRIP, however, this funding is generally reserved for those special request that have industry-wide application. All requests for special reports and/or services must, therefore, be approved by the Contracting Officer's Technical Representative (COTR). If reimbursement of costs will be required of the requesting agency, either in part or in full, the requesting agency will be so notified before implementation of the request commences.

5.4.1 Submittal Procedures

Special service requests must be submitted in writing to the Program Manager of the TRIP operating staff. A minimum of six weeks will be required to review and approve a special request. The actual time required for implementation will depend upon the complexity of the request. These factors should be carefully considered when estimating the submittal timing. A special request should contain as a minimum:

- Narrative description of the service(s) to be provided;
- Duration over which the service is to be provided;
- Hand-drawn samples of any report(s) to be provided and the required schedule for same;
- Narrative description of any analyses required, including:
  - required data elements (from Appendix A);
  - special data elements to be provided by the requestor for this purpose;

All special requests will be "logged in" by the TRIP staff, and written confirmation of receipt will be forwarded to the requestor.

5.4.2 Review Process

Copies of the special request will be made by the TRIP staff and forwarded to the COTR and the Change Review Board (see Section 5.2.2). The responsibilities of each group in the review process are outlined below:

- TRIP Staff:
  - determine if the requested service is within the capabilities of the TRIP Data Bank;
  - determine what, if any, special information or data must be supplied by the requestor to support the service;

- estimate the effect, if any, on routine operation of the Data Bank (cost; schedule; etc.);
- coordinate the activities of all groups involved in the review;

- Change Review Board:

  - assess the applicability of the special request to the industry;
  - determine if the requested special report(s) has application as a routine report;

- Contracting Officer's Technical Representative:

  - review the recommendations from the TRIP staff and Change Review Board;
  - determine if the special request is within the scope of TRIP;
  - determine funding opitons;
  - decide whether the special request should be brought to the entire Liaison Board.

Requirements for and the level of reimbursement of the costs for special reports and services will be determined by the COTR. It is incumbent upon the requestor in cases requiring reimbursement, to make the final decision as to wheter or not the TRIP staff should proceed with the implementation of the request.

Special requests, although not required to be, may be brought before the entire Liaison Board for review at a scheduled meeting. Such action may be advantageous when applicability of the special requst to the industry or as a routine report are not clearly defined.

5.4.3 Acceptance Notification and Implementation

All Liaison Board members and other users of TRIP will be sent written notification of approved special requests. The notification will include a narrative summary of the service to be provided and a description of associated reports, if any. The requesting agency will also be sent a copy of the implementation schedule and an estimate of when

the first (or only) output report will be delivered. The special report, when produced, will be mailed to the requestor, and will also detail the data that was used to produce the output, any analytical techniques that were employed and the effort envolved in the production of the report.

SECTION 6 - RELIABILITY ANALYSIS - A PRACTICAL APPROACH

Due to ever-increasing complexity of transit vehicles and the need for cost-effective means to operate and maintain these vehicles, assessment of vehicle performance has become essential. The information required to perform such an assessment can be obtained through monitoring vehicle operations and maintenance, specifically identifying equipment failures in the course of vehicle revenue service. The evaluation of this data provides the basis for classical reliability analysis.

In order to assess vehicle reliability in the classical sense, specific types of data relating to equipment failures must be available. However, operations and maintenance data submitted to TRIP does not contain all the data elements required to perform the analysis. Therefore, the reliability applications discussed here will not be the classical approach to reliability assessment but a practical approach, based on the available information provided by RRV TRIP.

6.1 DEFINITION OF RELIABILITY AND APPLICATION TO TRIP

Reliability is defined as the probability that a piece of equipment will perform its intended function for a specified time interval under stated conditions. It is related to other disciplines, such as maintainability, and is a factor in determining availability and dependability. Reliability assessment techniques range from sophisticated mathematical applications, to physical hardware investigations based on operations and maintenance considerations. An extension of reliability analysis would be to hardware specifications and standards and warranties which imply specific hardware performance criteria.

There are two important considerations essential to the use of reliability techniques on somewhat less than classical operations & maintenance data. First, a clear definition must be given of the technique being employed as supplied to the TRIP Data Bank and its expected results. Second, the available data must be analyzed in terms of its usefulness and applicability in a reliability contest. Generally, data collection systems in the transit industry

do not supply data in terms of classical reliability parameters such as failure rates or mean time to repair (MTTR). But, rates are available based on "trips to shop" and unique maintenance dates (associated with the trips to shop), since the specific mileage at a failure is not available unilaterally. Thus, the data generated by TRIP can be used to assess reliability even though it does not contain "classical" reliability such as failure rates and MTTR.

Figure 6-1 describes the relationship between the data submitted to TRIP and reliability/maintainability techniques and applications. TRIP data elements cover the data stored in and reported from the TRIP Data Bank.

The reliability/maintainability techniques shown in Figure 6-1 use the TRIP data elements to calculate values for the items described under reliability/maintainability applications. These techniques do not represent all reliability techniques that could be used, but those techniques which are applicable to the data avaiable. Explanations of these techniques will be given in the following sections. It should be noted that the mathematical descriptions of the techniques will be presented in a practical way and that no elaborate derivations of the techniques will be presented.

The items listed under reliability/maintainability applications represent those applicable to the available data. They cover a range of different uses, from technical requirements and planning to predictions. An explanation of their use will be provided in the following sections.

6.2 TRIP DATA

The data available from TRIP that will provide the information necessary to perform reliability analysis of rail rapid vehicles listed below. Each data type is described in terms of its RRV TRIP definition to eliminate any confusions with definitions of the same data type in another context.

- Event dates - dates of utilization (i.e.: the date on which mileage/hours is recorded), dates of inspections, and dates of unscheduled maintenance.

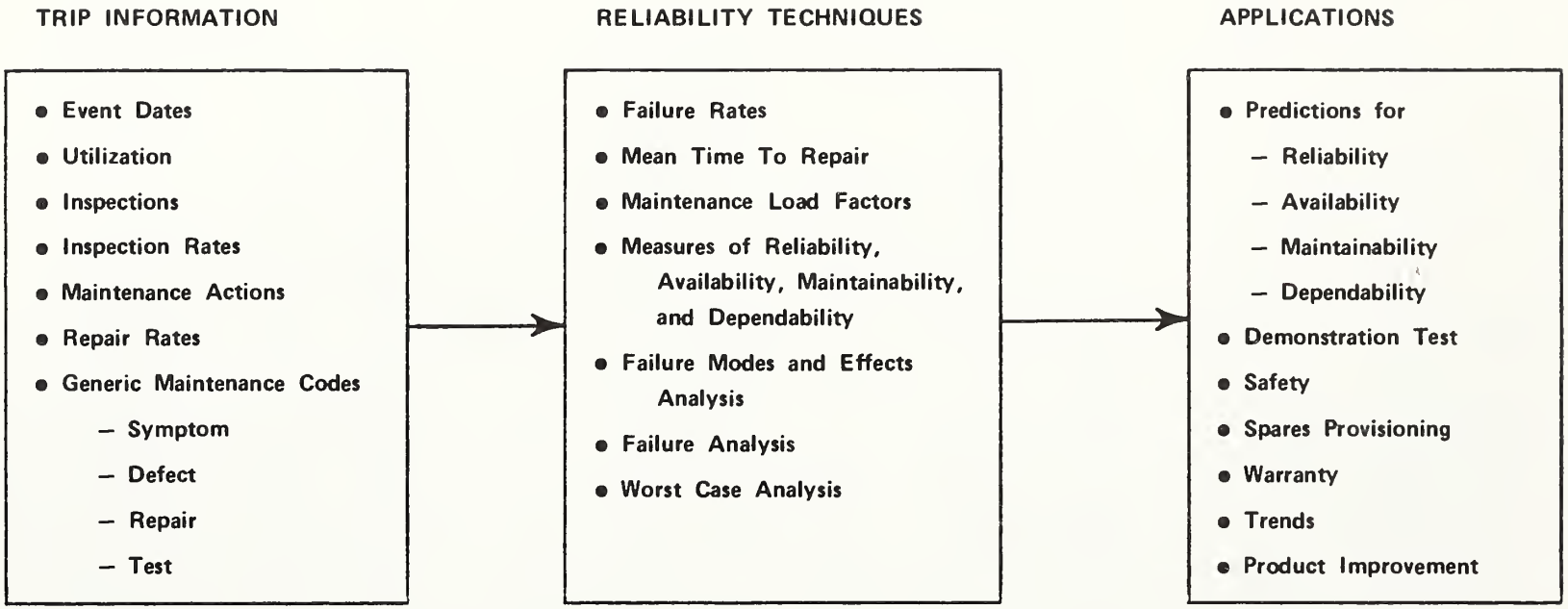


Figure 6.1 – TRIP DATA – RELIABILITY RELATIONSHIPS

- Utilization - cumulative mileage (or hours) for a vehicle as of a specific date.

- Inspections - number of times a vehicle was brought into the shop for an inspection, based upon unique record dates.

- Inspection interval/period - average miles/inspection.

- Maintenance Actions - number of times a vehicle was brought into the shop for unscheduled maintenance, based upon unique record dates.

- Repair Rates - number of maintenance actions/ten thousand miles of revenue service operation.

- Generic Maintenance Codes
  -Symptom: operational problems usually experienced by the vehicle operator;
  -Defect: reasons behind the observed symptom which are usually identified during inspection, trouble- shooting, testing, or maintenance activities;
  -Repair: actions taken to correct known defects or to treat observed symptoms; and
  -Test: actions taken to disclose a defect or to validate a repair.

6.3 RELIABILTY TECHNIQUES

The reliability techniques presented in this section represent a combination of mathematical and vehicle-related analyses. The mathematical analyses involve calculations based on data obtained from vehicle revenue service operations that are used to generate failure rates and predictions for reliabilty assessment. The vehicle analyses are based on data generated from maintenance information that are used to examine the cause of failure.

Each technique is described as follows. For TRIP, the emphasis has been upon the development of standard analytical techniques which can be applied, without tailoring, to all data regardless of the source. All analyses are, therefore, based upon those data elements which all data sources report.

6.3.1 Failure Rate Determination

Failure rates are numerical figures of merit that express the frequency of failure observed over a specific time interval. Failure rates can be expressed in failures per hour or, more commonly in transit operations, failures per mile.

In determining failure rates (λ), failures are defined as those incidents where a component was found to be inoperative or exceeded its design limits and, therefore, did not perform its intended function. Here, a distinction should be made between maintenance actions and repair actions. Maintenance actions refer to minor repairs, and repair actions refer to component repairs due to catastrophic failure or operation beyond its specified limits. Using event dates to identify failures, and the associated mileage at the failure, a failure rate may be calculated:

$$\text{Failure rate } (\lambda) = \frac{\text{number of failures}}{\text{number of miles}}$$

The reciprocal of the failure fare (λ) is called Mean Miles Between Failures (MMBF), which is the average operational mileage between equipment (vehicle, system, etc...) interruptions (i.e. miles between failures). Thus MMBF $= \frac{1}{\lambda}$ and may represent the in-service mileage of a component, system, vehicle, or vehicle series. Also, Mean Miles Between Maintenance Actions (MMBMA), and Mean Miles Between Repair Actions (MMBRA) may be calculated by dividing the number of miles traveled during a specified time period by the number of maintenance or repair actions performed during the same period. Time can be substituted for the mileage element, thus, MMBF can be translated into Mean Time Between Failures (MTBF).

6.3.2 Reliability Determination

Reliability is the probability that a component/system will perform satisfactorily over a specified time period.

To forecast equipment performance, reliability (R) can be predicted as follows:

$$R = e^{-\lambda t}$$

where: λ = failure rate (in time or miles)

t = time or miles

For example, the reliability of a component having a failure rate of 20 x 10^{-6} failures/mile (that is, 20 failures per one million miles) for 1,000 miles of operation would be:

$$R = e^{-\lambda t}$$
$$= e^{-(20 \times 10^{-6})(1000)}$$
$$= e^{-.02}$$
$$= .98$$

where: $\lambda = 20 \times 10^{-6}$

$t = 1000$

Note: whenever miles are used in the failure rate, miles must be substituted for t.

Thus the component has a 98 percent chance of operating successfully over 1,000 miles. And MMBF would be calculated as follows:

$$MMBF = 1/\lambda = 1/(20 \times 10^{-6} \text{ failures/mile})$$
$$= 50{,}000 \text{ miles/failure}$$

In the above formulation of R, if the number of failures is not available, number of repair actions may be substituted. If numer of repairs is used, "MMBRA" should be substituted for "MMBF."

6.3.3 Maintainability Determination

Maintainability is the probability of completing a repair in a specified time period. However, it is rarely measured in terms of probability, rather, it is usually expressed in a simpler expression, such as Mean Time To Repair (MTTR) and maintenance load factors.

MTTR represents the average time it takes to perform a number of repairs, and is usually expressed as:

$$MTTR = \frac{\text{Active Repair Times}}{\text{Number of Repairs}}$$

MTTR traditionally reflects only that time associated with the actual repair of hardware, excluding waiting time (i.e: tools or parts availability) and idle time (work breaks). However, if waiting and idle time is included in the MTTR, the MTTR can represent a more realistic measure of a vehicle or component's out-of-service time. MTTR could also be calculated from actual vehicle/component out-of-service time, but this is not the traditional approch as stated above.

Mean Labor Hours to Repair (MLHTR) can be substituted for MTTR. MLHTR calculation requires both the total number of labor hours and the number of repair personnel. While this calculation more closely represents the actual time spent on repairing a vehicle, the addition of waiting and idle time would result in and estimate of elapsed repair time for a vehicle. Thus, a vehicle's out-of-service time can be approximated.

The reciprocal of MTTR represents a repair rate (μ):

$$\mu = 1/MTTR$$

A Maintenance Load Factor (MLF) is a measure reflecting the repair load experienced in maintaining a vehicle/component. This factor is indicative of the unavailability of a vehicle due to maintenance, and is determined by multiplying the vehicle/component's failure rate and MTTR. Thus, MLF not only describes how ofter a vehicle/component fails, but also its out-of-service time, combining to illustrate the total impact of a vehicle/component on maintenance operations. In some cases, the most frequent failure of the most lengthy repair does not necessarily cause the greatest impact on maintenance operations. For example consider a system composed of components A, B, and C with the following failure rates and MTTRs:

Component	Failure Rate	MTTR	Load Factor
A	50	5	250
B	30	15	450
C	10	20	200

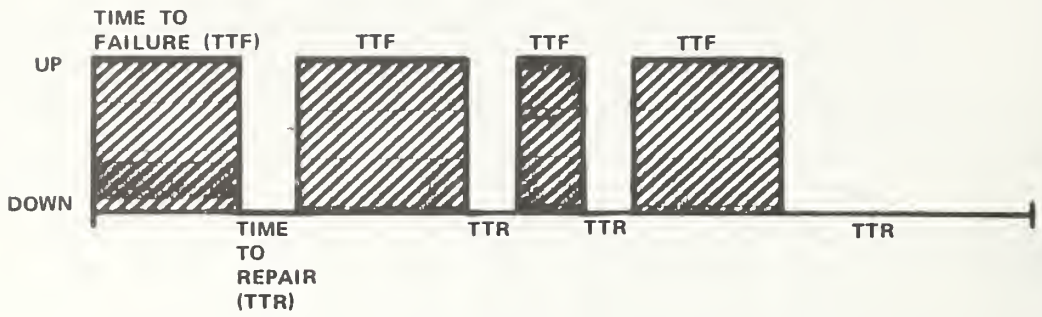
While A has the highest failure rate, and C has the highest MTTR, neither is the most significant contributor to the maintenance load (B is).

Where failure rates are expressed in failures/mile, equating miles to average miles per hour (operating speed) will allow the failure rate to be expressed in terms of hours. Therefore, MMBRA can be converted to a failure rate, λ, and expressed in failures per mile. Load factors serve as a valuable tool because they indicate not only components that are the major factor of vehicle unavailability, but also the maintenance requirements of a vehicle. Load factors can be formulated for individual components, assemblies, vehicles, vehicle senses, and fleets.

6.3.4 Availability Determination

Availability is the probability that an item (vehicle) is not in a state of failure at any time (i.e, operable). It is affected by both the reliability and maintainability of an item (vehicle). Availability is expressed as a percentage of a vehicle's operating profile and indicates its readiness for service regardless of whether it is in use or not. The derivation of the measure of availability (A) from reliability and maintainability can be shown as follows.

Consider a vehicle's operational profile:



where average of TTF = MTBF, and average of TTR = MTTR, so that:

$$A = \frac{UP}{UP + DOWN} = \frac{\frac{SUM\ OF\ TTF}{N}}{\frac{SUM\ OF\ TTF + TTR}{N}} = \frac{MTBF \text{ or } MMBF}{MTBF \text{ or } MMBF + MTTR}$$

where N = number TTF's followed by a TTR

If the expression is divided by MTBF,

$$A = \frac{\frac{MTBF}{MTBF}}{\frac{MTBF}{MTBF} + \frac{MTTR}{MTBF}} = \frac{1}{1 + \frac{MTTR}{MTBF}}$$

Since $MTBF = \frac{1}{\lambda}$,

$$A = \frac{1}{1 + \frac{MTTR}{MTBF}} = \frac{1}{1 + (MTTR)(\lambda)}$$

Since $(MTTR)(\lambda)$ = Load Factor,

$$A = \frac{1}{1 + (MTTR)(\lambda)} = \frac{1}{1 + \text{Load Factor}}.$$

Also, MMBRA or MMBF can be coverted into failure rates, described previously, to determine A.

6.3.5 Dependability Determination

Dependability is the probability that an item (vehicle is operationally ready for service. Dependability (D) is expressed as the product of reliability and availability. In simple terms, D can be stated as the probability that a vehicle will be ready for service (availability) and also work well during service (reliability).

D = A x R, where A is a function of MTBF (or MMBRA) and MTTR, and
R is a function of MTBF (or MMBRA)

D can be equated to Mean Miles Between Service Failures (MMBSF), which is indicative of the interruptions experience during a vehicle's revenue service on a particular route.

6.3.6 Other Reliability Techniques

Failure Modes and Effect Analysis (FMEA) is a hardware-related analysis which characterizes a specific failure and the consequences of that failure. FMEAs are used to trace the resulting effects of a problem from the initial sysmptom to its cause. Also, FMEAs may suggest a corrective action which can be applied in order to eliminate the problem. For example, FMEA may indicate a design change, a material change (such as protective coating) or a change in maintenance procedures used to correct the problem. In identifying failure modes, FMEAs also provide insight into the behavior of operating equipment since these modes cause failures such as fused contacts, leaking bearing seals, or excessive mechanical wear due to heat and stress. Thus, FMEAs provide information for reducing the number of failures, improving equipment performance and expediting maintenance.

From TRIP data, which provides symptom, defect, and repair descriptions, FMEAs can be developed. Also, maintenance action reports that indicate the component,

assembly, and system affected allows the event to be traced and permits the identification of the impact. Then, FMEA's may suggest a particular corrective action to correct the problem. TRIP data will not always provide the failure information necessary for conducting and ideal FMEA. However, the intent here is to describe the method and format that can be used when such data is available. To illustrate a format for describing FMEAs, the following table can be employed, where each equipment level is shown along with its fault impact:

FMEA

COMPONENT	ASSEMBLY	FAILURE MODE	SYSTEM	COMPONENT FAILURE MECHANISMS	IMMEDIATE EFFECT OF COMPONENT FAILURE	CORRECTION SUGGESTED

Needless to say, variations on the above table can be constructed to accomodate the conditions and problems that exist. Table 6.1 provides a basic example of FMEAs, denoting problems in the propulsion system of a rail car. In an FMEA, the correction suggested is accomplished by performing a failure analysis, shown in the following paragraphs.

Failure analysis is an evaluation which investigates the root causes of component failures. Given high failure contributors and/or trends in equipment that affect vehicle performance, failure analysis eliminates such problems by defining causes, which may then be corrected. Failure analysis can start with the development of repetitive failure modes, after which the affected component can be examined in detail to determine a corrective solution. For example, transmission problems can be traced to poor lubrication due to leakage from seal material which does not stand up to certain levels of stress. Electrical parts epoxied with a poor quality of material may crack to permit moisture collection and eventual electrical short curcuits. The variety of failure analysis applications depend upon the severity of the problem and the benefits to be gained from the analysis.

Worst Case Analysis is a technique used to evaluate equipment under the worst possible combination of operating conditions to determine its compliance with given specifications and its performance under such conditions. Such an analysis can be most effective when conducted during

Table 6.1 -- FMEA -- Propulsion System

Component	Assembly	System	Failure Mode	Component Failure Mechanisms	Immediate Effect of Component Failure	Correction Suggested
Gearbox vent	Traction gear box assembly	Propulsion	Vent closed	Mechanical jamming due to contamination or freezing	Gearbox pressure may exceed nominal 25 psi maximum	Check for seal rupture
Brush holders	Traction motor	Propulsion	Logic power supply tripped	Brush holders contaminated	Inoperative traction motor	Replace brush holders
Line to gearbox	Traction gearbox	Propulsion	Leakage or rupture	Fatigue, improper installation, etc.	Loss of gearbox pressurization	Replace line

the design stage of vehicles and when major modifications are done. In the latter case, modifications will affect equipment performance, therefore, it is necessary to examine system performance in the worst conditions. The adequacy of the modification can be measured by equating the equipment performance to system specifications.

6.4 APPLICATIONS

The following are suggested applications of the reliability techniques discussed in Section 6.3, above.

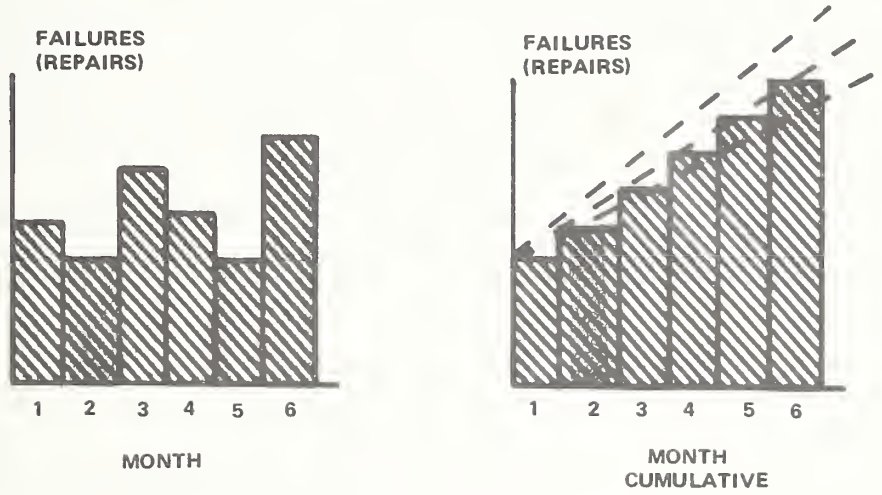
6.4.1 Predictions of Reliability, Availability, Maintainability, and Dependability

Reliability techniques can be used for a variety of applications ranging from mathematical predictions to program plans and specifications for equipment. Equipment performance forecasts in terms of reliability availability, maintainability, and dependability (RAMD) are the most significant use of predictions. These predictive techniques described in Section 6.3 are essential to assessing equipment performance. For example, in predicting reliability, equipment performance is determined; and, in predicting maintainability, the efficiency with which the equipment can be repaired is determined. As noted previously, both of these disciplines serve as factors in determining availability which is an important measure of equipment operational readiness. Furthermore, with the predictions of availability and reliability, dependability can be forcasted.

An example of these techniques and analysis would be a vehicle modification (or, product improvement) program in which a fleet is modified to improve its performance. This modification might include system redesign or the physical repositioning of equipment.

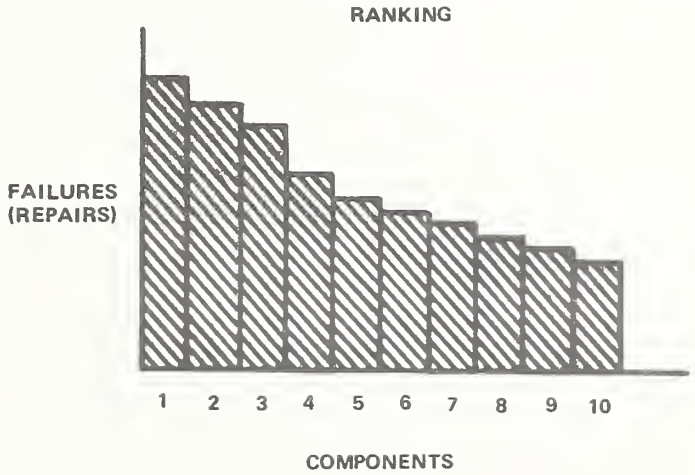
First, a reliability and availability assessment of the vehicles in the fleet should be made prior to the modification, in accordance with the techniques illustrated in Section 6.3. After the modification analyses should be performed at regular intervals (e.g.: monthly) in order to assess the impact of the modifications on performance. The

failure distribution and cumulative trend as in the following graphs should be examined to determine the frequency of failures and their impact on performance.



Also, in the cumulative graph, the progression of failures would indicate an increase or decrease as time goes on, and, coupled with MTTR, would reflect an increase or decrease in the maintenance load factor.

The failures can be ranked as follows:



From the above ranking, the top ten components can be selected and an FMEA can be performed to determine the cause of failure and, if necessary, a failure analysis can be performed to discover the root problem. Correcting these problems would result in an improvement in component reliability and availabilty, thus, improving fleet reliability and availability. After the modifications are

made, R and A should be assessed periodically and compared to the original estimates to indicate the change in performance resulting from the modification.

The above evaluation requires a data base sensitive to the needs of equipment performance assessment. Such a data base system should be capable of collecting, processing, and evaluating a wide range of operations and maintenance information to support sound reliability assessments. Furthermore, the data base should be able to support types of analyses other than those not mentioned in the above example. The TRIP Data Bank could provide such a service, without which no tangible evidence can be generated to properly assess vehicle performance.

6.4.2 Demonstration Tests

In buying new equipment, the quality and performance verification of the equipment requires a "demonstration test plan" that will show that the equipment complies with given requirements. The demonstration test plan provides an overall procedure for developing and conducting a test, including the definition of the equipment, test criteria, procedures, equipment sample, decision criteria, maintenance, and corrective action associated with each equipment procurement. To verify test results, a failure criteria specifying the classification and relevancy of failures is prescribed. The use of this plan assures that each equipment buy has been thoroughly examined and verified for compliance with the prescribed requirements.

The concept of this test plan provides a means for the manufacturer to prove the capability of his equipment and that it has been soundly designed to meet operating conditions. Each procurement will vary in quantity and quality; therefore, criteria for selecting a sample for testing are necessary. Since the equipment is produced in lots of various sizes, it is necessary to project the number of samples representative of the total buy. An example of the sample that would represent lot size is shown in the following table, which is derived from statistical methods:

Lot Sample Size

Lot Size	Recommended Lot Sample Size	Maximum Lot Sample Size
1-3	all	all
4-16	3	9
17-52	5	15
53-96	8	19
97-200	13	21
over 200	20	22

6.4.3 Safety

Safety analysis of equipment sometimes called a Failure Modes, Effects, and Hazzards Analysis (FMEHA), requires a format that will define the chain of events for a potentially hazzardous occurance and its resulting impact. This analysis describes individual failure modes, the interaction of these modes to result in equipment failure, and the resultant hazzards, if any. The above safety evaluation is from an operational point of view, but other considerations are also necessary. The evaluation of material, installation, procedues, and inspection procedures enhances the safety of a vehicle and insures operation with a minimum risk factor. All of these characteristics should be incorporated into one plan which insures that all aspects of safety have been covered. Such a plan, therefore, incorporates reliability techniques in order to measure the effectiveness of the safety features employed in a vehicle.

6.4.4 Spares Provisioning, Warrranty, and Trends

Spares provisioning can be determined by the use of failure rates, where the frequency of failures over a specified period of time implies the number of replacements required. The failure rate alone does not determine the required quantity of parts in stock since different systems in a vehicle can have similar components; thus, quantities of those components can be economized. But the failure rate does provide a foundation from which number of replacements can be estimated.

Equipment warranties require criteria upon which reliability requirements can be based. The number of failures, the type of failures, and the conditions under which failures occur and are verified are significant to the development of warranties. These criteria are best specified while reliability techniques are employed to determine the failures and associated conditions.

Trends are used to forecast equipment performance by compiling data generated by the reliability techniques which show the relative performance of the equipment over time.

APPENDIX A

TRIP DATA BANK RECORD FORMATS

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
A	01	UTILIZATION

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	A00000000000
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	A
SEQNO	SEQUENCE NUMBER	01
PERFR	PERFORMANCE REPORTED-FROM	
PERTO	PERFORMANCE REPORTED-TO	
MIPER	PERIOD MILEAGE	
UMICM	CUMULATIVE MILEAGE	
OHPER	PERIOD OPERATING HOURS	
UOHCM	CUMULATIVE OPERATING HOURS	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
C	01	SCHEDULED MAINTENANCE

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	A00000000000
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	C
SEQNO	SEQUENCE NUMBER	01
MMICM	CUMULATIVE MILES	
MOHCM	OPERATING HOURS	
MRPNO	REPORT NUMBER	
INDTE	INSPECTION DATE	
INTME	INSPECTION TIME	
MNLOC	MAINT SHOP	
INTYP	INSPECTION TYPE	
MPRNO	PART NUMBER	
REPNM	PART NAME	
MGDCD	GENERIC DEFECT CODE	
MGRCD	GENERIC REPAIR CODE	
RELOC	CAR LOCATION	
MFDCD	FAILURE DEFECT CODE	
MRPCD	MAINT REPAIR CODE	
MQTYR	QUANTITY	
METME	ELAPSED TIME	
MLAHR	LABOR HOURS	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
D	01	UNSCHEDULED MAINTENANCE REPAIR

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	D
SEQNO	SEQUENCE NUMBER	01
RMICM	CUMULATIVE MILEAGE	
ROHCM	CUMULATIVE OPERATING HOURS	
RRPNO	REPORT NUMBER	
MNDTE	MAINT DATE	
RMNLC	MAINT SHOP LOCATION	
HRDCD	HDW-ID	
PRTNO	PART NUMBER	
PRTNM	PART NAME	
PRTLC	LOCATION ON CAR	
RGSCD	GENERIC SYMPTOM CODE	
RGDCD	GENERIC DEFECT CODE	
RGRCD	GENERIC REPAIR CODE	
RGTCD	GENERIC TEST CODE	
SYMCD	SYMPTOM CODE	
RFDCD	FAILURE CODE	
PSFCD	PRIMARY/SECONDARY FAILURE CODE	
NTFCD	APPARENT FAIL	
RMRCD	CRT-ACT	
NORCD	DELAY CODE	
INSCD	TEST CODE	
RQTYR	QUANTITY	
RETME	ELAPSED TIME	
RLAHR	LABOR HOURS	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
D	02	UNSCHEDULED MAINTENANCE-S/N

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	D
SEQNO	SEQUENCE NUMBER	02
SNREM	SERIAL NUMBER OFF	
SNINS	SERIAL NUMBER ON	
REPPC	REPLACEMENT PART CONDITION	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
I	01	SYSTEM CONFIGURATION

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	A00000000000
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	I
SEQNO	SEQUENCE NUMBER	01

10001	TOTAL MILES
10002	TRACK CONSTRUCTION
10003	PERCENT GRADE
10004	PERCENT SUBWAY
10005	PERCENT ELEVATED
10006	NUMBER OF STATIONS
10007	AVERAGE SPACING
10008	NOMINAL SPACING
10009	MINIMUM VOLTAGE
10010	MAXIMUM VOLTAGE
10011	NUMBER SUBSTATIONS
10012	AVERAGE SUBSTATIONS SPACING
10013	TRACK GUAGE
10014	AVERAGE PASSENGER VOLUME
10015	BASE PASSENGER VOLUME
10016	PEAK PASSENGER VOLUME
10017	TOTAL VEHICLES
10018	TOTAL AVERAGE VEHICLES
10019	TOTAL REQUIRED VEHICLES

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
J	01	ROUTE CONFIGURATION

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	A00000000000
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	J
SEQNO	SEQUENCE NUMBER	01
11001	ROUTE	
11002	TOTAL MILES	
11003	NUMBER OF STATIONS	
11004	AVERAGE SPACING	
11005	MINIMUM SPACING	
11006	MAXIMUM SPACING	
11007	NUMBER OF SUBSTATIONS	
11008	SUBSTATION AVERAGE SPACING	
11009	SUBSTATION MINIMUM SPACING	
11010	SUBSTATION MAXIMUM SPACING	
11011	NUMBER OF CURVES	
11012	PERCENT CURVES	
11013	MINIMUM RADIUS	
11014	PERCENT GRADES	
11015	MAX UPHILL	
11016	MAX DOWNHILL	
11017	NUMBER TURNOUTS	
11018	TYPICAL SIZE	
11019	MINIMUM SIZE	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
K	01	ROUTE OPERATING INFORMATION

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	A00000000000
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	K
SEQNO	SEQUENCE NUMBER	01
12001	ROUTE	
12002	SCHEDULED SPEED	
12003	AVERAGE SPEED	
12004	CONSIST MINIMUM	
12005	CONSIST MAXIMUM	
12006	HEADWAY MINIMUM	
12007	SINGLE MINIMUM	
12008	SINGLE MAXIMUM	
12009	MERGED MINIMUM	
12010	MERGED MAXIMUM	
12011	MAXIMUM DWELL STATION	
12012	MINIMUM DWELL STATION	
12013	AVERAGE DWELL STATION	
12014	NUMBER TRAINS SCHEDULED	
12015	NUMBER CAR SCHEDULED	
12016	BASE LOAD FACTOR	
12017	PEAK LOAD FACTOR	
12018	MAXIMUM LOAD FACTOR	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
L	01	FLEET DATA

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	A00000000000
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	L
SEQNO	SEQUENCE NUMBER	01
13001	NUMBER OF CARS	
13002	CAR BUILDERS	
13003	FIRST YEAR OF SERVICE	
13004	SUBFLEET A NUMBER OF CARS	
13005	SUBFLEET A LOW CAR NUMBER	
13006	SUBFLEET A HIGH CAR NUMBER	
13007	SUBFLEET A INCREMENT	
13008	SUBFLEET B NUMBER OF CARS	
13009	SUBFLEET B LOW NUMBER OF CARS	
13010	SUBFLEET B HIGH CAR NUMBER	
13011	SUBFLEET B INCREMENT	
13012	MIN CARS PER TRAIN	
13013	MAX CARS PER TRAIN	
13014	MARRIED GROUP	
13015	SCHEDULED MAINT ROUTINE MILEAGE	
13016	SCHEDULED MAINT ROUTINE TIME	
13017	SCHEDULED MAINT MAJOR MILEAGE	
13018	SCHEDULED MAINT MAJOR TIME	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
M	01	SPECIFICATION DATA

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	A00000000000
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	M
SEQNO	SEQUENCE NUMBER	01
14001	SUBFLEET	
14002	NUMBER OF CARS	
14003	CAR BUILDER	
14004	LENGTH	
14005	WIDTH	
14006	TRUCK CENTERS	
14007	HEIGHT	
14008	WHEELBASE	
14009	MIN HORIZONTAL RADIUS	
14010	MIN VERTICAL RADIUS	
14011	TRUCK GUAGE	
14012	MAX SPEED	
14013	MAX OPERATING SPEED	
14014	NOMINAL ACCELERATION	
14015	MAX ACCELERATION	
14016	MIN ACCELERATION	
14017	MIN DECELERATION	
14018	MAX DECELERATION	
14019	NOMINAL DECELERATION	
14020	EMERGENCY DECELERATION	
14021	JERK RATE	
14022	EMPTY WEIGHT	
14023	SEATED LOAD WEIGHT	
14024	STANDING WEIGHT	
14025	CRUSH LOAD WEIGHT	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
N	01	VEHICLE DATA DOOR SYSTEM

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	AA0000000000
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	N
SEQNO	SEQUENCE NUMBER	01
15001	SUBFLEET	
15002	NUMBER OF CARS	
15003	CAR BUILDER	
15004	SIDE DOOR SUBCONTRACTORS	
15005	DOORS PER SIDE	
15006	PANELS PER DOOR	
15007	DOOR OPERATOR TYPE	
15008	DOOR OPERATOR MANUFACTURER	
15009	NUMBER PER CAR	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
N	02	VEHICLE DATA AIR COMFORT

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	AB0000000000
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	N
SEQNO	SEQUENCE NUMBER	02
15051	SUBFLEET	
15052	NUMBER OF CARS	
15053	CAR BUILDER	
15054	AIR COMFORT SUBCONTRACTOR	
15055	KILOWATTS	
15056	HEATING MANUFACTURER	
15057	NUMBER OF FANS	
15058	VENT CAPACITY	
15059	FRESH AIR MAKEUP	
15060	VENTILATION MANUFACTURER	
15061	AIR CONDITIONG CAPACITY	
15062	COMPRESSOR TYPE	
15063	AIR CONDITIONING MANUFACTURER	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
N	03	VEHICLE DATA COMMUNICATIONS

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	AC0000000000
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	N
SEQNO	SEQUENCE NUMBER	03
15101	SUBFLEET	
15102	NUMBER OF CARS	
15103	CAR BUILDERS	
15104	COMMUNICATIONS SUBCONTRACTOR	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
N	04	VEHICLE DATA AUXILIARY ELECTRICAL

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	AD0000000000
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	N
SEQNO	SEQUENCE NUMBER	04
15151	SUBFLEET	
15152	NUMBER OF CARS	
15153	CAR BUILDER	
15154	AUX ELECTRICAL SUBCONTRACTOR	
15155	TYPE	
15156	CAPACITY	
15157	OUT VOLTAGE	
15158	FREQUENCY	
15159	MANUFACTURER	
15160	NOM VOLTAGE	
15161	AMP-HR CAPACITY	
15162	NUMBER OF CELLS	
15163	CELL TYPE	
15164	MANUFACTURER	
15165	NOM VOLTAGE	
15166	RATING	
15167	MANUFACTURER	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
N	05	VEHICLE DATA PROPULSION SYSTEM

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	AE0000000000
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	N
SEQNO	SEQUENCE NUMBER	05
15201	SUBFLEET	
15202	NUMBER OF CARS	
15203	CAR BUILDER	
15204	PROPULSION SUBCONTRACTOR	
15205	CONTROL GROUP-TYPE	
15206	CONTROL GROUP-MANUFACTURER	
15207	MASTER CONTROLLER-TYPE	
15208	MASTER CONTROLLER-MANUFACTURER	
15209	TRACTION MOTOR-NO PER CAR	
15210	TRACTION MOTOR-TYPE	
15211	1 HOUR RATING	
15212	TRACTION MOTOR-MANUFACTURER	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
N	06	VEHICLE DATA FRICTION BRAKES

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	AF0000000000
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	N
SEQNO	SEQUENCE NUMBER	06
15251	SUBFLEET	
15252	NUMBER OF CARS	
15253	CAR BUILDER	
15254	FRICTION BRAKE SUBCONTRACTOR	
15255	SYSTEM-TYPE	
15256	SYSTEM-CONFIGURATION	
15257	APPLICATOR-TYPE	
15258	APPLICATOR-NO PER CAR	
15259	APPLICATOR-MANUFACTURER	
15260	ROTOR-NO OF PIECES	
15261	ROTOR-TYPE	
15262	COMPRESSOR-TYPE	
15263	COMPRESSOR-CAPACITY	
15264	COMPRESSOR-MANUFACTURER	
15265	PUMP-TYPE	
15266	PUMP-CAPACITY	
15267	PUMP-MANUFACTURER	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
N	07	VEHICLE DATA ATO/ATC CAB SIGNAL

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	AH0000000000
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	N
SEQNO	SEQUENCE NUMBER	07
15301	SUBFLEET	
15302	NUMBER OF CARS	
15303	CAR BUILDER	
15304	ATO/ATC SUBCONTRACTOR	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
N	08	VEHICLE DATA TRUCK AND SUSPENSION

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	AJ0000000000
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	N
SEQNO	SEQUENCE NUMBER	08
15351	SUBFLEET	
15352	NUMBER OF CARS	
15353	CAR BUILDER	
15354	TRUCK SUBCONTRACTOR	
15355	TRUCK TYPE	
15356	NUMBER PER CAR	
15357	AXLES PER CAR	
15358	WHEEL BASE	
15359	WHEEL DIAMETER	
15360	WEIGHT	
15361	TRUCK MANUFACTURER	
15362	SUSPENSION TYPE	
15363	SUSPENSION MANUFACTURER	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
N	09	VEHICLE DATA COUPLER AND DRAFT GEAR

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	AK0000000000
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	N
SEQNO	SEQUENCE NUMBER	09
15401	SUBFLEET	
15402	NUMBER OF CARS	
15403	CAR BUILDER	
15404	COUPLER SUBCONTRACTOR	
15405	MECHANICAL-TYPE	
15406	MECHANICAL-NUMBER PER CAR	
15407	MECHANICAL COUPLER MANUFACTURER	
15408	ELECTRICAL-TYPE	
15409	ELECTRICAL-NUMBER PER CAR	
15410	ELECTRICAL COUPLER MANUFACTURER	
15411	PNEUMATIC-TYPE	
15412	PNEUMATIC-NUMBER PER CAR	
15413	PNEUMATIC COUPLER MANUFACTURER	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
N	10	VEHICLE DATA POWER COLLECTION EQUIPMENT

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	AL0000000000
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	N
SEQNO	SEQUENCE NUMBER	10
15451	SUBFLEET	
15452	NUMBER OF CARS	
15453	CAR BUILDER	
15454	PWR COLLECT SUBCONTRACTOR	
15455	PANTOGRAPH TYPE	
15456	REACH	
15457	PANTOGRAPH MANUFACTURER	
15458	NUMBER PANTOGRAPH PER CAR	
15459	3RD RAIL SHOE TYPE	
15460	NUMBER 3RD RAIL SHOE	
15461	3RD RAIL SHOE MANUFACTURER	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
N	11	VEHICLE DATA CAR BODY AND STRUCTURES

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	AM0000000000
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	N
SEQNO	SEQUENCE NUMBER	11
15501	SUBFLEET	
15502	NUMBER OF CARS	
15503	CAR BUILDER	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
0	01	HARDWARE CONFIGURATION DATA

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	0
SEQNO	SEQUENCE NUMBER	01
16001	SUBFLEET	
16002	NOMENCLATURE	
16003	MANUFACTURER	
16004	MANUFACTURER PART NUMBER	
16005	PROPERTY PART NUMBER	
16006	PROPERTY STOCK NUMBER	
16007	PROPERTY MIS CODE	
16008	HIGHER ASSEMBLY,P/N	

RECORD TYPE	SEQUENCE NUMBER	RECORD DESCRIPTION
0	02	HARDWARE SPECIFICATION DATA

DATA NAME	DATA DESCRIPTION	VALUE IF CONSTANT
PART	GENERIC PART NUMBER	
SERIAL	GENERIC SERIAL NUMBER	
K-DATE	KEY DATE	(DDMMYY)
SUBDAT	SUBDATE	
RECTYP	RECORD TYPE	0
SEQNO	SEQUENCE NUMBER	02
16051	SUBFLEET	
16052	PROPERTY PART NUMBER	
16053	MANUFACTURER PART NUMBER	
16054	NOM SPEC FAILURE RATE	
16055	LAST REPORTED FAILURE RATE	
16056	COST OEM	
16057	LATEST COST	
16058	LENGTH X HEIGHT X WIDTH	
16059	WEIGHT	
16060	NOMINAL CAPACITY RATING	
16061	OVERLOAD CAPACITY RATING	
16062	QUANTITY IN SERVICE	

APPENDIX B

RAPID RAIL VEHICLE FUNCTIONAL HIERARCHY

TRANSIT RELIABILITY INFORMATION PROGRAM
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A000 . TRANSIT VEHICLE

AA00 . . DOORS & DOOR CONTROLS

AAA0 . . . END DOOR ASSY
AAAA . . . . DOOR LEAF ASSY
AAAB . . . . FRAME/CASEMENT/TRACKS
AAAC . . . . MOUNTING HARDWARE
AAAD . . . . CLOSING MECHANISM
AAAE . . . . CLOSER LINKAGES
AAAF . . . . CONTROLS & INTERLOCKS
AAB0 . . . CAB DOOR ASSY
AABA . . . . DOOR LEAF ASSY
AABB . . . . FRAME/CASEMENT
AABC . . . . MOUNTING HARDWARE
AABD . . . . CLOSING MECHANISM
AABE . . . . CLOSER LINKAGES
AABF . . . . CONTROLS & INTERLOCKS
AAC0 . . . SIDE DOOR ASSY
AACA . . . . DOOR LEAF ASSY
AACB . . . . FRAME/CASEMENT/TRACKS
AACC . . . . MOUNTING HARDWARE
AACD . . . . CLOSING MECHANISM
AACE . . . . CLOSER LINKAGES
AAD0 . . . SIDE DOOR CONTROLS
AADA . . . . DOOR CONTROLS, T/L
AADB . . . . T/L, SIDE DOOR CONTROL
AADC . . . . DOOR CONTROLS, CAR
AADD . . . . LOCAL DOOR CONTROL
AADE . . . . WIRING HARNESS
AADF . . . . PNEUMATIC PLUMBING

AB00 . . AIR COMFORT SYSTEM

ABA0 . . . VENTILATION SYSTEM
ABAA . . . . BLOWER ASSY
ABAB . . . . DUCTS & GRILLS
ABAC . . . . ENCLOSURE
ABB0 . . . HEATER ASSY
ABBA . . . . HEATING ELEMENTS
ABBB . . . . MOUNTS/SUPPORTS
ABBC . . . . ENCLOSURE
ABC0 . . . REFRIGERATION SYSTEM
ABCA . . . . A/C COMPRESSOR ASSY
ABCB . . . . CONDENSOR ASSY

ABCC . . . . EVAPORATOR ASSY
ABCD . . . . REFRIDGERANT PLUMBING
ABCE . . . . ENCLOSURE
ABDO . . . HVAC CONTROLS
ABEO . . . WIRING HARNESS - LOW-V
ABFO . . . CABLE HARNESS - HI-V

ACOO . . COMMUNICATIONS EQUIPMENT

ACAO . . . TRAIN RADIO
ACBO . . . TRAIN TELEPHONE
ACCO . . . TRAIN INTERCOM
ACDO . . . PUBLIC ADDRESS SYSTEM
ACEO . . . ANTENNA ASSY
ACFO . . . CONTROLS
ACHO . . . WIRING HARNESS

ADOO . . AUXILIARY ELECTRICAL

ADAO . . . POWER CONVERSION ASSY
ADAA . . . . POWER CONVERTER
ADAB . . . . REGULATOR
ADAC . . . . CNTLS & CKT PROTECTION
ADAD . . . . CABLE HARNESS - HI-V
ADAE . . . . WIRING HARNESS - LOW-V
ADBO . . . LOW-V POWER STORAGE
ADBA . . . . BATTERY ASSY
ADBB . . . . BATTERY CHARGER ASSY
ADBC . . . . WIRING HARNESS
ADCO . . . HARDWARE, MISC

AEOO . . PROPULSION SYSTEM

AEAO . . . MANUAL CONTROLS, T/L
AEAA . . . . MASTER CONTROLLER
AEAB . . . . AUXILIARY CONTROLLER
AEAC . . . . T/L, PROPULSION/BRAKING
AEBO . . . TRACTIVE EFFORT CNTLR
AEBA . . . . T/L DETECTORS
AEBB . . . . LOGIC & CONTROL - LOW-V
AEBC . . . . HIGH VOLTAGE SWITCH GEAR
AEBD . . . . POWER REGULATOR
AEBE . . . . LINE FILTER
AEBF . . . . CKT PROTECTION, PWR CKTS

AEBH . . . . ANNUNCIATION EQUIPMENT
AEBJ . . . . UNDERCAR WIRING - PROP
AECO . . . VENTILATION/COOLING
AEDO . . . TRACTION MOTOR ASSY
AEDA . . . . TRACTION MOTOR
AEDB . . . . SUPPORTS - MOUNTS
AEDC . . . . COUPLINGS
AEEO . . . EQUIPMENT BOXES

AFOO . . FRICTION BRAKE SYSTEM

AFAO . . . MASTER BRAKE CNTL, T/L
AFAA . . . . EMERGENCY BRAKE CONTROLS
AFAB . . . . PARKING BRAKE CONTROLS
AFAC . . . . T/L, BRAKE CONTROL
AFBO . . . SERVICE BRAKING CNTLR
AFBA . . . . LOGIC & CONTROL - LOW-V
AFBB . . . . ANNUNCIATION EQUIPMENT
AFBC . . . . CONTROL, HYD/PNEU
AFBD . . . . UNDERCAR WIRING - BRAKES
AFBE . . . . PIPING, HOSES & FITTINGS
AFCO . . . PUMP/COMPRESSOR ASSY
AFCA . . . . HYDRAULIC PUMP ASSY
AFCB . . . . COMPRESSOR ASSY
AFDO . . . BRAKE PARTS, ROTATING
AFDA . . . . FRICTION ELEMENT
AFDB . . . . MOUNT
AFEO . . . BRAKE PARTS, STATIONARY
AFEA . . . . SUPPORTING STRUCTURES
AFEB . . . . ACTUATOR ASSY
AFEC . . . . FRICTION ELEMENT
AFFO . . . PARKING/HAND BRAKE CNTLR
AFFA . . . . PARKING BRAKE APPLICATOR
AFFB . . . . HAND BRAKE APPLICATOR
AFHO . . . TRACK BRAKE ASSY
AFHA . . . . SUPPORTING STRUCTURE
AFHB . . . . BRAKE ELEMENT
AFHC . . . . CONTROLS
AFHD . . . . WIRING HARNESS
AFJO . . . TRACK SANDER ASSY
AFJA . . . . BULK STORAGE CONTAINER
AFJB . . . . DUCTS & CHUTES
AFJC . . . . VALVES & GATES
AFJD . . . . CONTROLS
AFJE . . . . WIRING HARNESS

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AH00 . . ATO/ATC - CAB SIGNAL

AJ00 . . TRUCK & SUSPENSION

AJA0 . . . FRAME ASSY
AJAA . . . . SIDE FRAME - LH
AJAB . . . . SIDE FRAME - RH
AJAC . . . . BOLSTER/SUSPENSION ADPTR
AJAD . . . . BOLT/WELD-ON EQUIPMENT
AJB0 . . . STABILIZERS
AJBA . . . . VERTICAL SHOCK ABSORBER
AJBB . . . . HORIZ SHOCK ABSORBER
AJBC . . . . STABILIZING ROD ASSY
AJC0 . . . SUSPENSION ASSY
AJCA . . . . MOUNTS & SUPPORTS
AJCB . . . . PRIMARY SUSPENSION
AJD0 . . . WHEEL & AXLE ASSY
AJDA . . . . WHEEL ASSY
AJDB . . . . GEARBOX ASSY
AJDC . . . . AXLE
AJE0 . . . DERAILMENT DETECTOR

AK00 . . COUPLERS & DRAFT GEAR

AKA0 . . . MECHANICAL COUPLER ASSY
AKAA . . . . COUPLER HEAD ASSY
AKAB . . . . DRAW BAR/DRAFT GEAR ASSY
AKAC . . . . ANCHOR ASSY
AKAD . . . . RADIAL CARRIER ASSY
AKB0 . . . ELECTRICAL COUPLER ASSY
AKBA . . . . CASE ASSY
AKBB . . . . CONTACT CARRIER ASSY
AKBC . . . . WIRING HARNESS
AKC0 . . . PNEUMATIC COUPLER ASSY
AKCA . . . . COUPLER HEAD ASSY
AKCB . . . . CHECKVALVE ASSY
AKCC . . . . PNEUMATIC FITTINGS
AKD0 . . . SEMI-PERM DRAW BAR ASSY
AKDA . . . . DRAW BAR/DRAFT GEAR ASSY
AKDB . . . . ANCHOR ASSY
AKE0 . . . COUPLER CONTROL ASSY
AKF0 . . . ARTICULATION SECTION ASSY

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ALOO . . POWER COLLECTION EQUIP

ALAO . . . POWER COLLECTOR ASSY
ALAA . . . . POWER CONTACT ASSY
ALAB . . . . SUPPORT STRUCTURE
ALAC . . . . MOUNT
ALAD . . . . POSITIONING MECHANISM
ALAE . . . . CKT PROTECTION
ALBO . . . T/L, PWR COLLECTOR CNTL
ALCO . . . POWER RETURN ASSY
ALCA . . . . GROUND BRUSH ASSY
ALCB . . . . GROUND RING ASSY
ALDO . . . CABLE HARNESS - HI-V

AMOO . . CAR BODY & STRUCTURES

AMAO . . . FRAME & UNDERCAR STRUCT
AMAA . . . . BOLSTER ASEMBLY
AMAB . . . . ANTICLIMBER ASSY
AMBO . . . SHELL, EXTERIOR
AMBA . . . . SIDE PANELS & FRAME
AMBB . . . . END PANELS & FRAME
AMBC . . . . ROOF PANELS & FRAME
AMCO . . . SHELL, INTERIOR
AMCA . . . . SIDE PANELS & TRIM
AMCB . . . . END PANELS & TRIM
AMCC . . . . CEILING PANELS & TRIM
AMCD . . . . INTERIOR BULKHEADS & TRIM
AMDO . . . FLOOR & FLOOR COVERING
AMDA . . . . FLOOR PANELS
AMDB . . . . FLOOR COVERING
AMEO . . . CARBODY INSULATION
AMFO . . . WINDOWS/SASH (X/DOORS)
AMFA . . . . GLAZING
AMFB . . . . SEALS & TRIM
AMFC . . . . FRAME
AMHO . . . SEAT ASSY, OPERATOR
AMHA . . . . FRAME ASSY
AMHB . . . . BACK CUSHION ASSY
AMHC . . . . BOTTOM CUSHION ASSY
AMHD . . . . POSITION ADJUSTMENT ASSY
AMHE . . . . BASE/MOUNT ASSY
AMJO . . . SEAT ASSY, PASSENGER
AMJA . . . . FRAME ASSY
AMJB . . . . BACK CUSHION ASSY
AMJC . . . . BOTTOM CUSHION ASSY

AMJD . . . . STANDEE HANDHOLDS
AMKO . . . HANDHOLDS & WINDSCREENS
AMKA . . . . MOUNTS & SUPPORTS
AMKB . . . . STANDEE HANDHOLDS
AMKC . . . . WINDSCREEN & TRIM
AMLO . . . LIGHTING, EXTERNAL
AMLA . . . . FIXTURE ASSY
AMLB . . . . WIRING HARNESS
AMLC . . . . CNTLS & CKT PROTECTION
AMLD . . . . T/L, EXTERNAL LIGHTING
AMMO . . . LIGHTING, INTERNAL
AMMA . . . . FIXTURE ASSY
AMMB . . . . WIRING HARNESS
AMMC . . . . CNTLS & CKT PROTECTION
AMNO . . . DEST & RUN NUMBER SIGNS
AMNA . . . . SCROLLING ASSY
AMNB . . . . LIGHTS & FIXTURES
AMNC . . . . ENCLOSURE ASSY
AMND . . . . WIRING HARNESS
AMNE . . . . CNTLS & CKT PROTECTION
AMNF . . . . T/L, DESTINATION SIGN
AMPO . . . INTERCAR CLOSURE
AMRO . . . OPERATOR'S CONSOLE
AMSO . . . SAFETY EQUIPMENT
AMTO . . . MISCELLANEOUS EQUIPMENT

APPENDIX C

UNIVERSAL COMPONENT CODES

0H..ACCELERATOR
01..ACCUMULATOR
0F..ADAPTER
02..ALARM
03..ALTERNATOR
04..AMMETER
05..AMPLIFIER
06..ANCHOR
07..ANNUNCIATOR
08..ANODE
09..ANTENNA
0A..ARM
0B..ARMATURE
0C..ARRESTOR
0D..ASSEMBLY
0E..AXLE
..
0S..BAFFLE
0T..BALLAST
1P..BAND
0U..BAR
0V..BARRIER
0W..BATTERY
0X..BEARING
0Y..BELL
0Z..BELLOWS
10..BELT
11..BLADDER
1S..BLADE
12..BLOCK
13..BLOWER
14..BOARD
15..BOARD, P.C.
16..BOARD, TERMINAL
1R..BODY
17..BOLT
18..BOOT
19..BOX
1A..BRACE
1B..BRACKET
1C..BRAKE
1T..BREATHER
1D..BRIDGE
1E..BRUSH
1F..BRUSHHOLDER
1H..BULB
1J..BULKHEAD
1K..BUMPER
1L..BUS
1M..BUSHING
1N..BUZZER
..
21..CAB
22..CABINET
23..CABLE
24..CALIPER
25..CAP
26..CAPACITOR, FIXED
27..CAPACITOR, VARIABLE
28..CAM
29..CARRIER
4X..CARTRIDGE
2A..CASE
2B..CASING
2C..CASTING
2D..CATHODE
2E..CELL,BATTERY
2F..CELL,PHOTOELECTRIC
2H..CHAIN
2J..CHARGER
2K..CHASSIS
2L..CHOKE
2M..CHOPPER
2N..CHUTE
2P..CHUTE, ARC
2R..CIRCUIT BREAKER
2S..CLAMP
2T..CLEAT
2U..CLIP
2V..CLOCK
2W..CLUTCH
2X..COIL
2Y..COIL, BLOWOUT
2Z..COLLAR
31..COMMUTATOR
32..COMPRESSOR
33..CONDENSOR
34..CONDUIT
35..CONNECTOR
36..CONSOLE
37..CONTACT
38..CONTACT, MOVEABLE
39..CONTACT, STATIONARY
3A..CONTACTOR
3B..CONTACTOR, MAGNETIC
3C..CONTACTOR, PNEU
4Y..CONTAINER
3D..CONTROL
3E..CONTROLLER
3F..CONTROLLER, CAM, BINARY
3J..CONTROLLER, CAM, ROTARY
3K..CONVERTER
3L..CORD
3M..COUNTER, ELECTRONIC
3N..COUNTER, ELECTROMECH
3P..COUNTER, MECHANICAL
3R..COUPLER
3S..COUPLING

3T..COVER
3U..CRADLE
3V..CRANK
3W..CRANKCASE
3X..CRANKSHAFT
3Y..CURTAIN
3Z..CYLINDER
..
4A..DAMPER
4B..DECODER
4C..DEHYDRATOR
4D..DEMODULATOR
4E..DETECTOR
4W..DIAPHRAGM
4F..DIODE
4H..DIODE, LIGHT EMITTING
4J..DIODE, ZENER/REFERENCE
4K..DISC
4L..DISCRIMINATOR
4M..DISPENSER
4N..DISPLAY
4P..DOOR
4R..DRAWER
4S..DRIVER
4T..DRIVER, RELAY
4U..DRUM
4V..DUCT
..
5A..ENCLOSURE
5B..ENCODER
5C..EQUALIZER
5D..EVAPORATOR
5F..EXCHANGER, HEAT
5E..EXCITER
..
5S..FAN
5T..FASTENER
5U..FIELD
5V..FILTER
5W..FILTER, AIR
5X..FILTER, ELECTRICAL
5Y..FILTER, MECHANICAL
5Z..FILTER, OIL
61..FITTING
62..FIXTURE
63..FLYWHEEL
64..FOLLOWER
65..FRAME
66..FUSE
..
6H..GASKET
6J..GAUGE, PRES, HYD
6K..GAUGE, PRES, PNEU
6L..GAUGE, TEMPERATURE
6M..GEAR
6Y..GEARBOX
6N..GENERATOR, POWER
6P..GENERATOR, SIGNAL
6R..GLAND
6S..GLASS
6T..GLAZING
6U..GONG
6Z..GOVERNOR
6V..GROMMET
6W..GROUND
6X..GUIDE
..
7A..HAMMER
7B..HANDLE
7C..HANDSET
7D..HANGER
ZZ..HARDWARE
7E..HARNESS
7F..HEAD
7H..HEADSET
7J..HEATER
7K..HEATER, ELEMENT
7U..HINGE
7L..HOLDER
7M..HOPPER
7N..HORN
7P..HORN, ARC
7R..HOSE
7S..HOUSING
7T..HUB
..
8A..IMPELLER
8B..INDICATOR
8C..INDUCTOR, FIXED
8D..INDUCTOR, VARIABLE
8S..INSERT
8E..INSULATION
8F..INSULATOR
8H..INTEGRATED CIRCUIT
8J..IC, ANALOG
8K..IC, DIGITAL
8L..IC, MEMORY
8M..IC, MICRO-PROCESSOR
8N..INTERLOCK
8P..INTERPOLE
8R..INVERTER
..
91..JACK
92..JOINT
93..JOURNAL
94..JUMPER
..
A1..KEEPER

A2..KEY
A4..KIT
A3..KNOB
..
AA..LAMINATION
AB..LAMP
AC..LATCH
AD..LEAD
AE..LENS
AF..LEVER
AH..LINER
AJ..LINING
AK..LINKAGE
AL..LOCK
AM..LOGIC
AN..LUG
..
B1..MAGAZINE
B2..MANIFOLD
B3..MARKER
B4..METER
B5..MICROPHONE
B6..MIXER
B7..MODEM
B8..MODULATOR
B9..MODULE
BA..MOLDING
BB..MONITOR
BC..MOTOR, AC
BD..MOTOR, DC
BE..MOTOR, HYDRAULIC
BF..MOTOR, PNEUMATIC
BH..MOTOR-ALTERNATOR
BJ..MOTOR-GENERATOR
BK..MOUNT
BL..MUFFLER
..
BW..NUT
..
C1..ODOMETER
C2..OIL
C3..OPERATOR
C4..ORIFICE
C5..O-RING
C6..OSCILLATOR
C7..OUTLET
..
CA..PACKING
CB..PAD
CC..PADDLE
CD..PANEL
CW..PAWL
CE..PIN
CF..PINION
CH..PIPE
CJ..PISTON
CX..PIVOT
CK..PLATE
CL..PLUG
CM..PLUNGER
CN..POLE
CV..POST
CP..POWER SUPPLY
CR..PRINTER
CS..PROTECTOR
CT..PULLEY
CU..PUMP
..
DA..RACE
DB..RACK
DC..RADIO
DD..RAIL
DE..RAMP
EK..RATCHET
DF..RC NETWORK
DH..REACTOR
DJ..RECEIVER
DK..RECEPTACLE
DL..RECTIFIER
DM..REFLECTOR
DN..REGISTER
DP..REGULATOR
DR..REGULATOR, CURRENT
DS..REGULATOR, FLOW
DT..REGULATOR, FREQUENCY
DU..REGULATOR, POWER
DV..REGULATOR, PRES
DW..REGULATOR, VOLTAGE
DX..RELAY
DY..RELAY, OPEN FRAME
DZ..RELAY, PC MOUNT
E1..RELAY, PLUG-IN
E2..RELAY, TIME DELAY
E3..REPEATER
E4..RESISTOR, FIXED
E5..RESISTOR, VARIABLE
E6..RESTRICTOR
E7..RETAINER
E8..RETURN
E9..REVERSER
EA..RIBBON
EB..RING
EC..RISER
ED..RIVET
EL..ROCKER
EE..ROD
EF..ROLLER
EH..ROTOR, AC MOTOR

EJ..ROTOR
..
F1..SCREEN
F2..SCREW
F3..SEAL
F4..SEAT
F5..SENSOR
F6..SENSOR, PROXIMITY
F7..SENSOR, VOLTAGE
F8..SEPARATOR
F9..SHAFT
FA..SHELL
FB..SHIELD
FC..SHIM
FD..SHOCK ABSORBER
FE..SHOE, BRAKE
FF..SHOE, THIRD RAIL
FH..SHUNT
FJ..SHUTTER
FK..SLEEVE
FL..SLIP RING
FM..SOCKET
FN..SOLENOID
FP..SNUBBER
FR..SPACER
FS..SPEAKER
FT..SPEEDOMETER, ELECTRONIC
FU..SPEEDOMETER, MECHANICAL
FV..SPIDER
FW..SPLINE
FX..SPRING
FY..STARTER
FZ..STATOR
HK..STOP
H1..STRAIN RELIEF
H2..STRAINER
H3..STRAP
H4..STUD
HL..SUMP
H5..SUPPORT
H6..SUPPRESSOR
H7..SWITCH
H8..SWITCH, CAM
H9..SWITCH, KNIFE
HK..SWITCH, LIMIT
HA..SWITCH, PRES, HYD
HB..SWITCH, PRES, PNEU
HC..SWITCH, PUSH-BUTTON
HD..SWITCH, ROTARY
HE..SWITCH, STEPPER
HF..SWITCH, THERMAL
HH..SWITCH, TOGGLE
HJ..SWITCHBOARD

J1..TACHOMETER, ELECTRONIC
J2..TACHOMETER, MECHANICAL
J3..TANK
J4..TELEPHONE
J5..TERMINAL
J6..THERMOSTAT
J7..THRESHOLD
JW..THROWER
J8..THYRISTOR
J9..TIE
JA..TIMER
JB..TIRE
JC..TRACK
JD..TRANSDUCER, PRES, HYD
JE..TRANSDUCER, PRES, PNEU
JF..TRANSDUCER
JH..TRANSDUCTOR
JJ..TRANSFORMER
JK..TRANSISTOR
JL..TRANSMITTER
JM..TRANSPORT
JN..TRAY
JP..TREAD
JR..TRIM
JS..TRIP
JT..TUBE
JU..TURBINE
JV..TURNBUCKLE
..
KA..VALIDATOR
KB..VALVE
KC..VALVE, CHECK
KD..VALVE, EXPANSION
KE..VALVE, MAGNET
KF..VALVE, MANUAL
KH..VALVE, RELIEF
KJ..VALVE, SOLENOID
KM..VANE
KK..VOLTMETER
KL..VOLTRAP
..
L6..WASHER
L1..WASHER, FLAT
L2..WASHER, LOCK
L7..WEDGE
L8..WEIGHT
L3..WHEEL
L4..WINDING
L5..WIRE
..
LA..YOKE

APPENDIX D

REPORT OF NEW TECHNOLOGY

No new technology was developed during this contract. However, a significant amount of rail transit equipment reliability data was collected which aided in the establishment of a national transit reliability Data Bank. The Data Bank will promote the amalgamation of current reliability efforts within the transit industry; provide a focal point for a consolidated reliability effort; and assist the transit industry in creating, developing, and improving revenue service operations.

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